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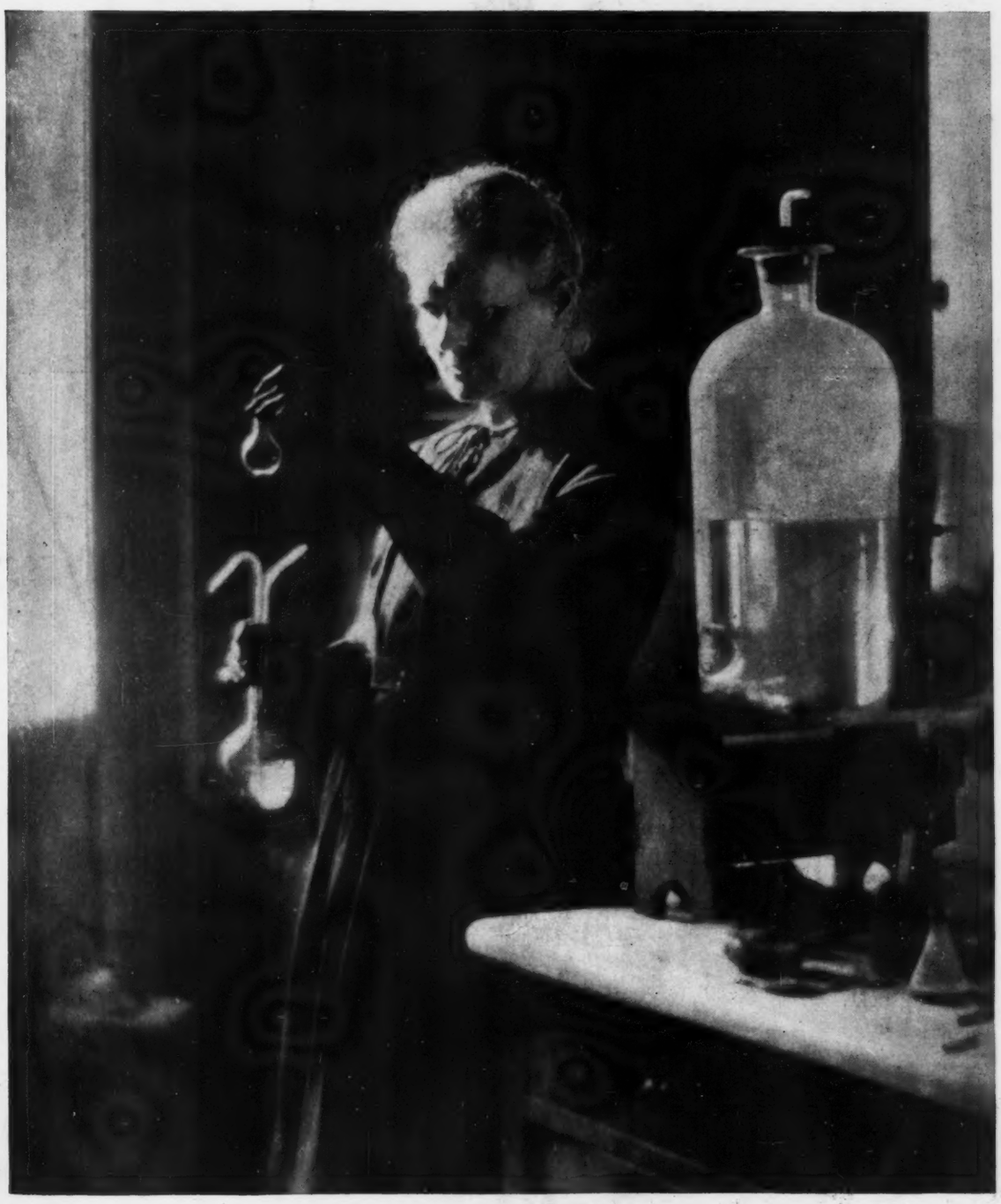
May 14, 1921



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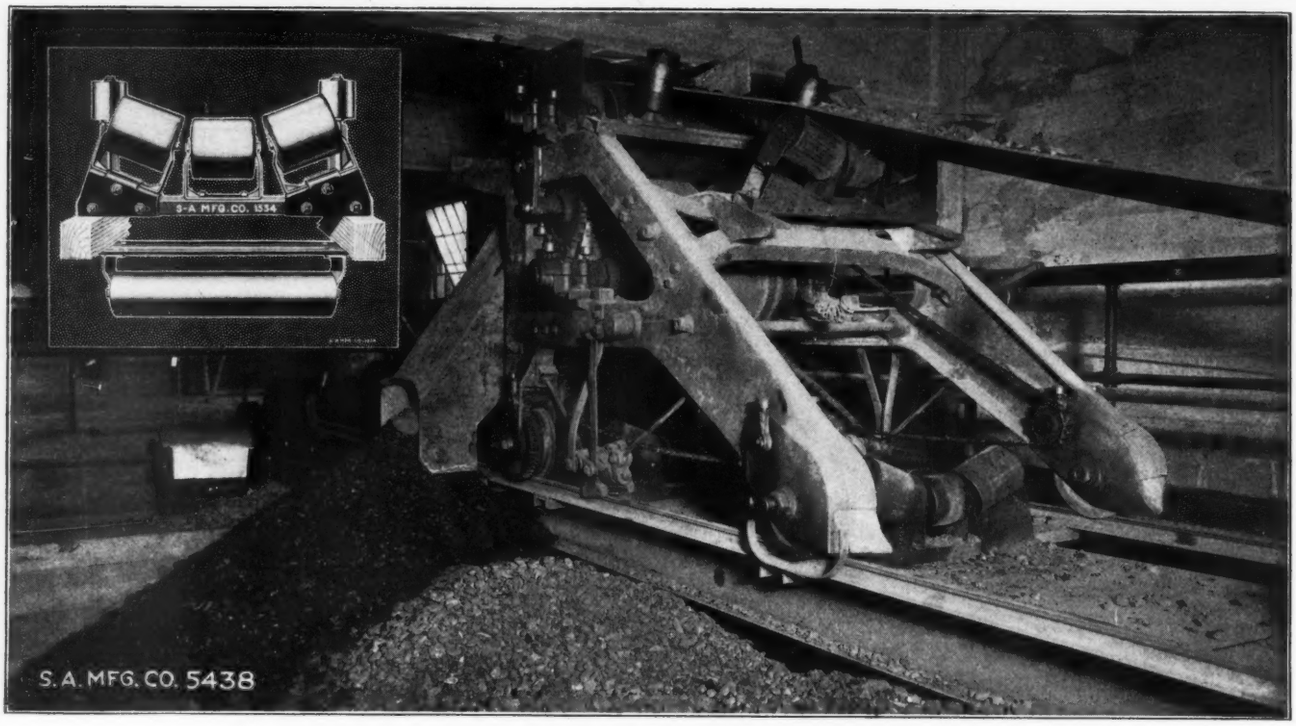

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Progress of the Engineers' Licensing Movement

THE MOVEMENT for licensing engineers has gone further than is realized by most mining engineers. A synopsis of recent legislation as given in the last number of the official organs of the American Association of Engineers notes that the Arizona bill is a law, having been signed by the Governor on March 19; also the Colorado bill, signed by the Governor on April 4, "through efforts of the Colorado Section of Engineering Council." The Minnesota bill has become a law since the writing of the synopsis in question.

On the other hand, the Montana bill, introduced by the A. A. E. chapter, met with the opposition of the Montana Society of Engineers and was killed. The New Mexico bill passed the Senate but failed in the House; and the same fate befell the Missouri bill on March 18. In California a bill sponsored by the A. A. E. was withdrawn from the Legislature. In Nevada, the bill met with the opposition of mine operators and died in committee.

Passing from the distinctly mining states, a bill for this purpose has become a law in North Carolina; in New Jersey the bill became a law April 1; in Indiana on March 10; in Tennessee, on April 19. In Arkansas and South Dakota the bills have failed. In Texas the bill passed the Senate, but failed in the House. In South Carolina the bill failed in committee, "due to opposition from the farmers." Bills are pending in the legislatures of North Dakota, West Virginia, Ohio and Connecticut, being opposed in the latter two states by the Manufacturers' Association. In Pennsylvania, the bill pending in the Legislature is being opposed by various engineering societies in the state, and also by the Scranton Correspondence School, "it being their contention that the law might be construed against the so-called practical engineer." It has passed the House. In New York, there now exists a licensing law, and a fight is on to so amend it as to permit corporation license. In Georgia, Nebraska, and Oklahoma, the movement is being pushed.

We have taken no editorial stand on this important question, but are watching its developments with interest. It behooves all mining engineers to do the same. We know that many are on each side of the question. The rest should ponder, and in their respective states frankly thrash out the merits and demerits of the plan.

Pending Tax Revision

THE SECRETARY OF THE TREASURY has recommended a repeal of the excess-profits tax, and there is no doubt that this will be done, as the sentiment is in favor of it on all sides. The main objection to the tax is that it defeats its own ends: the goose that lays the golden egg quits laying under the harrying—what incentive to lay at all if the tax collector pounces on the egg and devours it, and no little golden goslings can ever be hatched? The Government needs revenue, and must adopt some method whereby it can get it.

The Secretary also is against excessive income-tax surtaxes. He would have the maximum rate 40 instead of 73 per cent. Dropping suddenly from the rarefied regions of high finance to the daily round, he would remove the petty tax on soda water, shirts, shoes, and the like.

As important as the method of raising necessary Government funds is the necessity of reducing Government extravagance. The present rate of Federal expenditure means a contribution of $250 per annum, on the average, from every family in the United States. When state, county, and city taxes and the rest are added, we are quite unnecessarily tax-burdened. We have paid high, as a nation, for what we have obtained. We need a business manager in Washington, who should be assistant to the President, and who should watch over the business operations of the Government (which at present have no head) while the President performs the duties of statesmanship.

The Hardening of Copper

THAT the hardening of copper is a lost art is generally believed. Many of our readers will therefore be interested in the answer to a question put to us by a university professor, which appears on page 826 of this issue. To be frank, we ourselves had only very hazy ideas on the subject until the matter was brought before us. It is true that ancient implements of copper and bronze were of a workmanship not since surpassed and were of a hardness not common nowadays in manufactures of the red metal. However, this is not to say that the ancient results could not be duplicated today if it were necessary; that is, if metals more adapted to the purpose were not now available. The ancient cutting edges were no doubt hardened chiefly by the well-known "Armstrong" method—hammering. Also, it is likely that the crude methods of reduction resulted in the presence of more impurities than are found in the electrolytic product of today. Copper is made much harder and tougher by relatively small amounts of other substances, such as silicon, phosphorus, and tin.

Copper is one of the oldest known metals. Before any metals were used, there was what we call the Stone Age. Then, about 4,000 B.C., archeologists tell us that bronze began to be used in southeastern Europe. Copper and tin are found together in Cornwall and China, but whether it was from the smelting of mixed ores or alloying of the two metals that bronze was made is unknown. Some think that the use of bronze was preceded by that of pure copper, the alloy afterward being found to have more desirable properties. At any rate, the use of bronze gradually spread, and by 1,800 B.C. was general throughout Europe. Then iron began to be used, and with its development, including that of steel, the making of utensils of hardened copper was gradually superseded. So, beside a high degree of technical skill in the working of copper and its alloys bred

by sheer necessity as a result of the lack of a more appropriate substance with which to work, it is unlikely that the ancients possessed any important secrets of which we are not aware today. Furthermore, there is a possibility, as is pointed out elsewhere, that as a result of our knowledge of why iron can be hardened, and of our ability to harden aluminum, we may yet discover something regarding the working of copper far in advance of what was known in the reputed good old days.

Back to Silver in Russia

THE AGE OF PAPER has probably reached its zenith, in respect to the belief in the magic of paper notes with sums of money printed thereon, as really practicable currency, to gravely pass from hand to hand as something of value, and to give in exchange for good corn and pork. The simple believers in this sort of magic, from the spectacled American economist to the Russian peasant, are beginning or accomplishing their disillusionment, according to the amount of paper they have swallowed and left undigested. Reports from Russia state that the Lenine autocracy has authorized the coinage of silver, since the peasants are tired of filling their hay wagons with rouble notes whenever they go to market to buy a pair of horses.

There should be a great demand for silver for coinage when the stricken nations of Europe are in a strong enough position so that they can satisfy their hunger to handle real money again, for silver coinage has been cleaned out of those nations, like France, whose currency is depreciated, and sold as bullion in countries where the currency has greater value. This, of course, will be the immediate result of the Russian move. Its silver coin issued will disappear as completely as it does in India or China.

Colorado School of Mines

LEGISLATORS are as a rule a genial lot of men. The particular group which made the "investigation" of present and past conditions at the Colorado School of Mines and reported to the Colorado Legislature is no exception to the rule. The "report," which has just come to our attention, conforms to type and falls into the class rendered conspicuous by a liberal use of milk of lime. It is inept, inconclusive, and not helpful to the school. A skilful surgeon will not cover over a suppurating wound with tightly-drawn bandages and send the patient away with optimistic statements as to his condition. Rather will he open up the wound and cleanse it with liberal use of disinfectants and arrange for proper drainage. He will not delude the patient with misleading statements.

Placed alongside of the report of the American Association of University Professors, the Legislature's report suffers by comparison. The one is definite; the other vague. The report of the American Association of University Professors goes to the roots of the problem and states:

"The conditions which were brought out in this investigation, unless remedied without delay, will prove most disastrous to the future of the school. To attract and to retain teachers of superior qualifications, an institution must protect them from administrative tyranny and from interference with their professional functions and responsibilities, and must maintain such standards as will permit men of character to enter and to remain in its service without loss of professional self-respect. This can only be accomplished if the authorities of the State of Colorado will appoint trustees who are competent to select and to support a president who has the proper educational ideals."

C. Erb Wuensch, in the December, 1920, number of the *Colorado School of Mines Magazine* exposes internal conditions at the school in an exceedingly frank manner. Undoubtedly he was in an excellent position to ascertain most of the facts. Having had the benefit of about seven years' varied mining experience after his graduation from the school in 1914, Mr. Wuensch must be credited with a reasonable maturity of judgment, and his presentation is entitled to careful consideration. Mr. Wuensch says: "Conditions are fundamentally wrong at Golden and require immediate correction. The present system of trusteeship by appointment made by the Governor has had a long trial and been proven a failure. The reason is because of the difficulty of selecting men of the proper character—men free from local prejudice—who possess the proper educational ideals." Thus the second indictment in the case emphasizes the weakness of the trustees as did the first. We pass over most of the legislative report and take the liberty of quoting the following paragraph from p. 12:

"Your committee finds that the management of the School of Mines by the present Board of Trustees is highly efficient, and no well-grounded criticism can be made as to the character, qualifications, or energetic efforts of the members of the board to promote the best interests of the institution; but your committee feels that it would be fitting and proper to have a larger representation of the mining industry on the board."

The legislative committee, despite its sweeping commendation of the Board of Trustees, appears, however, to have some slight doubts and endeavors to protect itself by suggesting additional members. We fail to see how this would improve matters unless the additional representation were thoroughly qualified.

The last paragraph but one on p. 12 is as follows:

"Again, the presence of a citizen of Golden seems to be a source of dissatisfaction, and while not questioning in the least the efficiency, integrity and devotion to the best interests of the school, of the present member from that city, your committee would suggest that in the reorganization of the board, if that be decided upon, the members should be selected from elsewhere, in order that no local influence may prevail."

There is much between the lines of this paragraph. It affords small comfort to the citizens of Golden. The succeeding paragraph reveals that the legislative committee is a little dubious about its own findings, and proposes to provide one governing body for all of the state schools. This plan, as well as the recommendation for continued investigation, is merely a time-worn political device that may be compared to the ostrich burying its head in the sand.

After our careful reading of the report we cannot help feel that President Alderson must have blindfolded the committee and led the members around one of the mountain boulevards, returning them safe and sound to the state capitol.

The fundamental weakness of the Colorado School of Mines lies in a succession of inept boards of trustees, and the vain effort of continuing the attempt to administer the school by catering to the selfish interests of a pitifully small town. The legislative report states that after H. C. Parmelee was refused reappointment

in 1917, the Board of Trustees "sought long and faithfully to secure a competent man who would take the position and restore the school to its former standing and usefulness. After weeks of searching for a competent man it was finally decided to ask Dr. Alderson to come and take the place, which, after much urging, he consented to do."

The facts were, we are reliably informed, that no educator of prominence could be prevailed upon to take the place, and Dr. Alderson was the last resort. Since Dr. Alderson's appointment there have been twenty-two faculty changes in three years, in a faculty which ranged in numbers from seventeen to twenty-five. This is the best evidence that internal conditions have not improved. With such a large faculty turnover, efficient instruction and proper standards are impossible.

The State of Colorado has put a large amount of money into this institution, but has been singularly inert in demanding that a clean, wholesome school be maintained. Until public opinion takes an active part, the institution will, in our opinion, continue to be a political bean bag, not to be seriously considered as a mining school of high ideals and real worth.

Suburban Lots in the Desert

A NEW DEVICE for unloading mineral, or hopefully mineral, property on the public has been devised by the Great Southern Sulphur Co., through its Eastern representative, Carroll C. Hodges, of 52 Broadway. The plan distinctly suggests a background of experience in selling New Jersey house lots, now applied to the mining industry.

The lands in question are in west Texas, in Culberson County, where sulphur deposits have long been known, but where their profitable commercial exploitation has thus far remained an unsolved problem, owing to their remoteness from transportation and markets and the abundant and even superfluous resources and production of the great sulphur mines of the "domes" in Louisiana and East Texas. There are two thousand acres in all in the company's property, all of which are supposed to be underlain by sulphur. The Great Southern Sulphur Co. is not exactly a going one, according to the prospectus, but it is "95 per cent a going one." We wonder what that means. We are not going to the dinner tonight, but we are just about 95 per cent going. The net result is that we stay at home. Is it something like that?

In putting up your coin and embarking in the sulphur-producing business "You are invited into an enterprise which has no competitors," for the simple reason, as one might say, that no sulphur produced is so absolutely pure as that which this company is going to turn out. A glance at the photographs of tents and our "Laboratory and Laboratory Building, both 14 x 22" and our "Department Heads House, 16 x 60" ought to satisfy the most incredulous. We assume that this is the "plant, 95 per cent completed," from which, we are told, the "Great Southern Sulphur Co. will soon be in a position to supply sulphur in endless quantities." Now, the reason we have poor spotted paper on the market today (saith Mr. Hodges), and the reason that we have so many blow-outs on our automobile tires, is on account of the inferior quality of sulphur used in the manufacture of paper and rubber.

As to the investment. You are not asked to buy stock, but to buy lots, each one a hundred square feet in area (10 x 10), for $100 each. A dollar a square foot is pretty good for desert real estate, whether or not seasoned by sulphur. The company does not intend to sell more than 60,000 lots, which will, if sold, bring in $6,000,000. The company agrees to work all these lots as a whole, and pay the lot holder seven-eighths of the profits: all the company wants is one-eighth. An 87½ per cent royalty on the net should be good enough for the property owner—i.e., the lot holder!

Certainly, in view of this, one cannot doubt the altruistic motives of the promotion, which the circular proclaims. We find in various parts of the circular that the promoters are "truly honest men," and that the proposition is "clean, fine, open, fair—the kind of thing you like." But as to the 87½ per cent of the net profits—will there be any profit? Assuredly, saith Mr. Hodges: "The net profit from the sulphur plant is estimated at $1.75 per ton," and "with a sulphur plant of 1,000 tons' monthly capacity, the net profit would be $175,000 per month." Simple arithmetic, you see; and we are forced to believe that the directors are "men of modern and aggressive ideas" when we turn to our sulphur quotations at $18 a ton.

Sulphur is the mainstay of this company, but by far not its last ditch. The company also owns a "lake of soda" in New Mexico. This at once calls up visions of an unlimited fountain of soda, or soda fountain, but it does not sound so attractive when we find it to be a dry lake, or playa deposit. This soda will yield a net profit of only $20 per ton, according to the circular, but even at that, a 500-ton plant will yield net $10,000 a day, and when we refer to our quotations of sodium sulphate, at $20 per ton f.o.b. mines in Arizona, we cannot but admire the management in which the cost of production is going to be zero, and the market price of the product the net profit.

And still the company is not at all dependent on these earnings for prosperity. "In addition to these minerals there have been discovered several caves which are rich in bat guano, readily marketable as a fertilizer." . . . "It is estimated that this fertilizer will eventually pay all operating expenses, leaving the operation of the sulphur and soda plants practically a clear profit to the lot holders."

How much profit on your investment in your 10 x 10 desert lot? Why, sir, "Conservative estimates place the possible return to stockholders at from 35 to 60 per cent on each $100 invested." The circular saith not whether the 35 to 60 per cent is per cent per annum, or just per cent: but either way you look at it, no mean standard is set, and it is increasingly clear that "big, vital men" are "squarely in back" of this enterprise.

The circular brings in Mr. Courtenay de Kalb, through a little article which he published in the *Manufacturers' Record* concerning the sodium sulphate deposit in New Mexico. It is safe to say that if Mr. de Kalb had known the use to which his article would be put, he would not have taken the trouble to write it.

Altogether, who can doubt that, according to Mr. Hodges, the promotion of this enterprise "went much further than the highest principles of business require." . . . "They went much further than the law of the land requires." Especially the postal laws.

Should sulphur, soda, and guano all fail the enterprise, there is still the unlimited hot air of the desert, which, shipped to New York and peddled in small lots by the company's eastern representative, will, if skilfully handled, pay a handsome profit.

WHAT OTHERS THINK

The Naica Case

The furore caused by the decree of the Supreme Court of Mexico in the Naica case, its apparent bearing upon foreign-owned mine titles and property rights generally, and the aspersions heaped upon the Mexican courts as a result of it seem to justify analysis of its legal aspects. The moral aspects of the controversy from first to last give ground for discussion, to say the least; but with these the courts could have nothing to do. Condemnation or justification of the decree must rest upon its interpretation of the law, for that is the function of the courts.

The story was told in the *Engineering and Mining Journal* of Feb. 12, 1921. What is the law?

Article 95 of the Code of Commerce of Mexico (federal) establishes ten requisites "which public writings of association must contain for their validity"; and Article 96 of the same code reads: "The omission of any of the requisites prescribed in the preceding article is cause of nullity of the social pact which shall be declared at the request of any of the partners (*socios*)."

The writing of the constitution (articles of incorporation) of the Compañía Minera de Naica, S. A., failed in all of these requisites. The company early sought to cure the defects by a vote of ratification and the adoption of a code of bylaws which embodied the provisions prescribed by the law for the writing of a constitution; but the meeting of shareholders in which this action was taken was not legally called nor conducted, and even if it had been, the action would have been without legal effect on the original pact.

The attempt of the shareholders in 1897 to vacate the shares of Stopelli for non-payment of an increase in their par value was undoubtedly illegal; the law definitely provides that full-paid shares may not be assessed.

The validity of the so-called contract of August, 1905, between an alleged attorney-in-fact of the Stopelli estate and the company, seems to have been well refuted on the grounds that the attorney was not legally the representative of the estate; that, even if he had been, a judicial order was necessary to the act, as there were minor heirs, which order was not obtained, and that this attempted settlement had to do only with Stopelli's twenty-five shares of the cash capital and the dividends thereupon and not with his interest in the property nor the capital shares which represented it.

The Supreme Court decree was on appeal from a decision of the lower court in a suit brought by the Stopelli heirs on the ground that the organizers of the company failed to establish in the writing of the constitution those things which the law definitely prescribes as necessary to its validity and whose omission the law definitely declares to be cause of nullity of the social pact, which may be declared on petition of any of the partners. The defendant company contended that the plaintiffs were not shareholders; but the court finds that they are such of right; that they are the successors in interest of one of the original partners; that as such they have the right to ask judgment of nullity, and so decrees that the company, never having been legally constituted, does not exist; therefore the ownership of the property is *ipso facto* still vested in the original owners, and orders the company liquidated and the property with its fruits restored to the original owners.

The court further finds that the attempts to cure the defects in the writing of the constitution were futile, as they were corporate acts; *i.e.*, acts of the supposed corporation *per se* and not of the original partners to the pact as individuals. The doctrine is that the writing of a constitution is a pact among individuals and can be reformed or amended only by those same individuals or their individual successors in interest. A body which does not exist cannot cure itself of an infirmity. A couple not legally married cannot decree the legality of acts growing out of the illegal association, but can only by actually marrying validate the acts of the conjugal partnership from the moment of marriage. The only possible cure for the company would have been a new incorporation, with cession of property rights directly from the original owner.

Notwithstanding that in the finding of the court the corporation as such does not exist, the association or partnership for the purpose of legal service and judgment does exist under the provisions of the Civil Law, Article 2,222, which recognizes to such ends *Sociedades de Hecho*; that is, association or partnership of fact for the moment.

The company's claim of cure by prescription is unfounded because prescription cannot run either in favor of or against a person or body which does not legally exist; it cannot create a fact out of nothing.

It is unfortunate that this important case should have been brought to a decision at the moment when Mexico, by the conduct of her new national administration, is seeking conscientiously to re-establish herself in the good graces of the world. In the average Anglo-Saxon mind, habituated to the operations of the common law and to judgments in equity, it is at once catalogued as a rank miscarriage of justice, a violation of vested rights, a plain case of tampering with the court. But Mexican jurisprudence cannot be judged by the standards of America or England. Mexico is not a common-law country; its laws are statutory. There is no "equity side" to the Mexican courts; they are strictly *Juzgados de derecho*; in this sense courts of law, of the strict letter of the law. Their judges are bound by their jurisprudence no less than by their *protestas* of office to interpret the law according to their reading of its letter. The ideals of all law are justice and equity, but justice and equity are not law.

Undoubtedly, in the attempted incorporation Stopelli and his associates acted ignorantly. It would appear to a disinterested observer that the company was equally ignorant or else culpable in allowing such grave faults in its charter, which was also its property deed, to go uncorrected. In no country does ignorance of the law exempt from its penalties. The lesson is, know the

law in so far as it concerns you, or employ a lawyer; better, do both. Trust in God and keep your powder dry.

AN AMERICAN LAY STUDENT OF MEXICAN LAW AND PRACTICE.

Copper-Leaching Practice

I have read with interest the comments of G. D. Van Arsdale in *Engineering and Mining Journal* of April 16 on my paper presented at the Montreal meeting of the Canadian Institute of Mining and Metallurgy. That paper will be published in full in the June *Bulletin* of the Institute, and will, it is hoped, clear up some of the difficulties found in the abstract. However, as many will not see the complete paper, I offer a few words of explanation.

In ordinary milling practice "setting free a mineral" does mean separating it from the gangue. In leaching practice there is no reason why complete separation should be necessary—all that is required is that the solvent have access to the copper mineral and that the latter be sufficiently crushed to dissolve in a reasonable period of time. The meaning of the phrase as used in hydrometallurgy is therefore modified to that extent.

Mr. Van Arsdale states that in leaching with sulphuric acid the chief objection to the solution of oxides of iron and aluminum comes "from an increased acid consumption and not from fouling the solutions." This may be true of alumina, which is inert, but it is not true of iron oxide, unless we include under acid consumption that lost in discarding solutions *to eliminate the iron.* This is properly chargeable to fouling of the solution. One might infer from Mr. Van Arsdale's statements that iron was desirable in the solutions at Ajo, but if so they certainly have "too much of a good thing." Foul solutions remain a bugbear even in practice. To the credit of hydrometallurgists be it said that methods have been found to overcome some of the difficulties due to the presence of iron, but these methods do not obviate the necessity of discarding a large volume of solution containing some copper and much acid —the latter either free, if electrolytic deposition be used throughout, or latent, if still partly combined with copper.

Regarding my statements that when ammonia and ferric salts were the solvents electrolytic precipitation of the copper was impossible, I should perhaps have said that in those cases the commercial possibility of electrolytic precipitation remained to be demonstrated. I freely acknowledge that the "impossibility" of today often becomes the reality of tomorrow.

In the extract of my article I was made to state that upward percolation "extracts the copper more rapidly and reduces channeling." I do not see this any more clearly than does Mr. Van Arsdale, but I quoted the assertion in my paper as the opinion of the Ajo metallurgists, who have adopted upward percolation. I also said that their "method" resulted in ten times as much water-soluble copper in the tailings as at Chuquicamata. It is quite true, but I referred to their whole leaching method, and not simply to the system of percolation. The direction of percolation I consider important, especially in washing the tailings. For a detailed treatment of this question I must refer readers to the June *Bulletin* of the C. I. M. M.

Mr. Van Arsdale would like acid consumption stated in pounds per ton of copper extracted instead of per ton of material treated. Neither method is entirely satisfactory in comparing plants, for consumption depends principally upon the nature of the gangue and the method of precipitation used, and only to a minor extent upon the copper content of the ore or tailings.

Mr. Van Arsdale's preference for graphite anodes is well known (for a detailed discussion of the advantages of lead and graphite anodes see *Trans.* A. I. M. E., Vol. 55, pp. 843-853), and I myself went so far as to predict their use in large-scale operation. My paper, however, deals rather with present than future practice. I am glad that Mr. Van Arsdale mentioned the value of ferrous sulphate as a depolarizing agent. It is well that something can be said in favor of iron in the electrolyte.

It appears to me an undeservedly severe criticism of the practice at Ajo and Chuquicamata to state that "there is nothing very complicated or difficult in getting a yield of 2.5 to 3.0 lb. of copper per kilowatt-hour." The New Cornelia and Chile Exploration companies would be thankful to get half of those yields. The theoretical value, electrolyzing cupric sulphate solutions without depolarizing agents, is only 2.14 lb. per kilowatt-hour. Assuming an ampere efficiency of 85 per cent, and taking 2.0 volts as the minimum that will give a satisfactory current density under the conditions mentioned, the yield becomes 1.11 lb. Of course, better than this can be done with graphite anodes and efficient depolarization, but it is doubtful if at the above plants this change would be profitable, if at all possible.

Deschenes, Que. F. E. LATHE.

The Fatigue of Drill Steel

In *Engineering and Mining Journal* of April 16, the interesting article by Frank H. Kingdon on drill steel and editorial comment on the same prompt me to state briefly our experience with steel breakage. We have driven a tunnel 8,000 ft. and at the breast we drove an upraise vertically 1,200 ft. to drain 200 ft. of water out of an old mine. Most of this work was done through excessively hard rock, and, although the best drill steel obtainable was used, there was an enormous amount of breakage, due not only to the hard rock but also to the fact that our steel was terribly punished by our water Leyners operating on 130 lb. of air.

At the time our breakage was at its worst, with the steels breaking near the shank, near the bit, in the middle, and every other place, I read an article in the *Scientific American* on the fatigue of metals and determined to try an experiment. From a new bar of steel two starters were made. Number one was sent in the tunnel, started a hole, was immediately brought out, resharpened and sent in to start another hole. This routine was kept up until twelve holes had been started, and then the starter broke in the middle like glass.

The second starter was used on one hole and then allowed to "rest" the next day. The third day another hole was started, and so on until 107 holes had been commenced in very hard rock, when it also broke in two.

Before this experiment was completed, we purchased three times the amount of steel we had been using and used one-third of it every third day. Our steel breakage under the plan outlined became negligible.

I have explained to several mining men our plan of handling steel, and in every instance where the plan has been put in operation it has been a marked success. It is certain that steel does get tired, and is greatly benefited by a rest. CARROLL M. CARTER.

Ohio City, Col.

Study of Underground Electrical Prospecting—Part II*

Dip and Strike of Tilted Strata—Experiments in Iron Region of Calvados—Spontaneous Polarization Due to Chemical Action Resulting From Oxidation—Electrical Prospecting Will Probably Never Give Certain and Precise Results

BY C. SCHLUMBERGER
Translated under the direction of the author by Sherwin F. Kelly

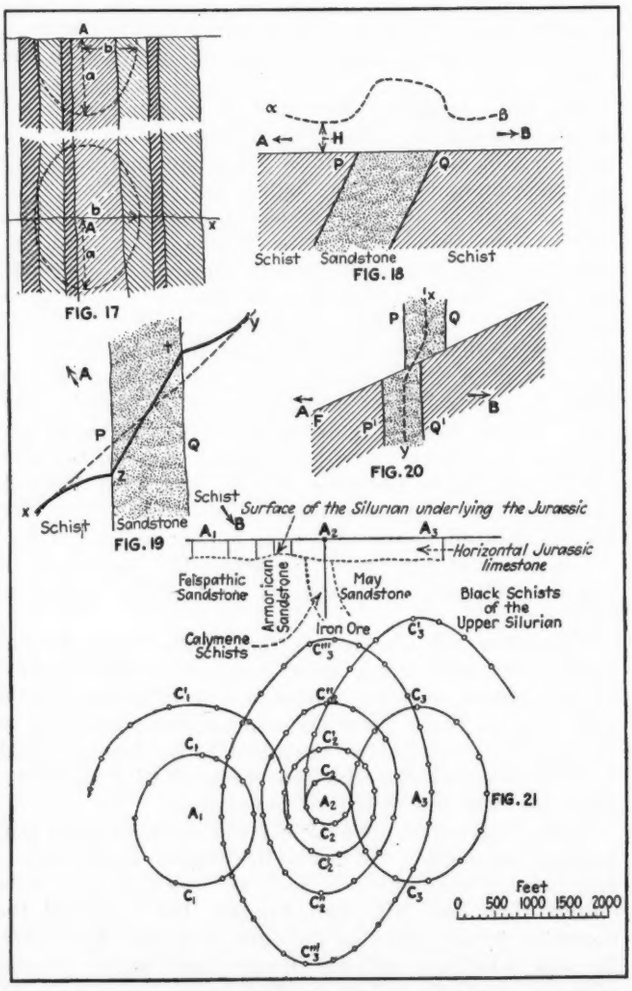
Theoretical Study of Tilted Strata

A TERRAIN OF TILTED STRATA, composed of an alternating series of different rocks, acts after the manner of an anisotropic body, possessing an electrical conductivity greater in the direction of the bedding than perpendicular to it. This holds, no matter what the nature of the layers may be, provided they have different specific resistances. Place a contact A in a stratified mass, supposing the stratification to be vertical, the other contact having been placed at a greater distance (Fig. 17). The equipotential surfaces in the ground are flattened ellipsoids of revolution about Ax as an axis which is perpendicular to the plane of stratification. The superficial curves of equal potential are ellipses elongated in the direction of stratification. The elongation is greater the greater the anisotropy of the ground. If the beds are inclined, the elongation of the ellipses is less pronounced, and it disappears when they are horizontal.

Strata covered by thick sediments necessitate experimenting on large curves whose radius is double the thickness of the covering. The better conductor the covering sediments are, the more they interfere with the elongation of the curves, so that no precise rule can be given. In practice, overlying sediments are often horizontal and present few irregularities in the relief, and this causes no deformation in the curves, but acts merely as a more or less opaque screen. Operating with curves of large diameter only, the general direction of stratification can be studied over a wide territory.

Conclusive practical studies of the determination of the direction of dip have not been obtained, but, theoretically, there is an unsymmetrical deformation of the surface intersections of the ellipsoid of equipotentials that would indicate the direction of dip. The practical difficulty arises from the lack of homogeneity of the soil. The existence of a drill hole makes it possible to make a contact deep in the earth, and thus discover the direction of the dip by the direction of the decentering of the surface equipotential curves with respect to the point vertically above.

Assuming stratification vertical or nearly so, it is possible to locate a stratum (assumed to have, for example, double the specific resistance of the surrounding material) by determining the profile of the electric field as shown in Fig. 18, the two points being placed a great distance, 1,000 to 2,000 meters, apart. The method of refraction, Fig. 19, presents another possibility. In this case the line AB is inclined at about forty-five degrees to the strike. The curve of equipotential, on being traced across, registers distinct deflection on both sides of the stratum of higher resistance. Presence of overlying covering suppresses the phenomenon to a certain extent. For the deformations to be perceptible, the difference between the specific resistances of the two rocks must be great enough to be recognized, and the thickness of the stratum sufficiently large in comparison to the thickness of the cover.



ELECTRICAL DETERMINATION OF THE CHARACTERISTICS OF STRATA

As always, the deep-lying phenomena are perceptible only if pronounced. When the overlying material is irregular, a great difficulty is introduced.

Displacement by faulting can be detected where pronounced differences in resistance of the faulted stratum and its inclosing formations exist. Fig. 20 shows an equipotential line following a stratum of sandstone faulted at F.

*Part I of this paper appeared in the May 7 issue of *Engineering and Mining Journal*.

In 1912, 1913, and 1914 I carried on a number of experiments in the region of Calvados, in northwest France, that may serve as a practical illustration of a stratigraphical study, based on the foregoing theoretical principles. The Silurian beds studied consist of the compact Armoricain sandstones at the base. Next above are the Calymene schists, containing iron ore and having a thickness of about 100 meters; above these formations are the layers of May sandstones and the Upper Silurian, which are differentiated from the Armoricain sandstones by alternating schists and sandstones. The Silurian beds are generally tilted and covered by horizontal Jurassic limestones. The relief of the surface is not pronounced.

Experiments at Fierville-la-Campagne were carried on in a region of relatively thick overburden, where the older strata were well known through a series of drill holes. The Silurian is nearly vertical. The Jurassic, which is rather argillaceous, an unfavorable condition, is from 60 to 90 meters thick.

The direction of stratification was studied by means of equipotential curves. In the upper part of Fig. 21 is given the profile of the beds examined, as determined in seven drill holes aligned perpendicularly to the strike. The lower part of the figure shows several equipotential curves, traced around three successive contacts A_1, A_2, and A_3, and the other contact, B, remained fixed at about three kilometers from the region being explored. From these curves may be drawn the following observations:

The contact A_1 is placed above feldspathic sandstones of the Lower Silurian. They produce the curves C_1 and C'_1, which have a radius of 250 to 500 meters and are approximately circular.[10] From that it may be concluded that the mass is sensibly isotropic; therefore but slightly fissured in the direction of stratification, without alterations of differently constituted layers.

The contact A_2 was placed near a drill hole which had encountered the Calymene schists and the iron ore. The curve C_2, of 100 meters' radius, is nearly circular, because the corresponding equipotential surface does not penetrate far enough into the Silurian, and so is under the influence of the horizontal overburden. The curve C'_2 begins to show a slight ellipticity, but this is clearly manifested only for C''_2 with an average radius of 400 meters, much greater than the thickness of the Jurassic, which is about 100 meters. The curve C''_2 presents the same deformation, and its length is more than 3.5 kilometers. The region is therefore anisotropic, its maximum conductivity (that is to say, the direction of stratification) being parallel to the long axis of the equipotential ellipses. The contact A_3, over the Upper Silurian, also gives definitely elongated equipotential curves C_3 and C'_3; therefore it may be concluded that the series is made up of beds of different nature (schists and sandstones). These results are in conformity with those given by the drills. Notably, the strike of the Silurian coincides exactly with the direction of elongation of the curves.

Near the iron-ore deposits the contact of the Calymene schists with the Armoricain sandstones, which constitutes a definite geological horizon, was searched for by refraction of the curves and by the electric field profile. The refraction of the curves was visible in the field, but was not clear, and might have escaped observation if the result had not been known beforehand.

The indications given by the profile of the electric field were more satisfactory. They are represented in Fig. 22. The two contacts A and B having been placed on opposite sides of the contact sought, and at a distance of about a kilometer from it, three profiles were drawn, following the lines x_1y_1, x_2y_2, x_3y_3, parallel to the direction AB. In each one of these the field presents a marked discontinuity at the points P_1, P_2, and P_3, corresponding closely to the juncture sought. The Armoricain sandstones, being of higher specific resistance than the schists, indicate their presence by a sharp rise of the field; that is to say, of the rate of fall of the current, due to the resistance per meter.

It is interesting to note the rapidity with which these profiles may be established. With a personnel of two operators, two assistants, and a chauffeur, six and a half hours sufficed to place the line AB, pass the current, and trace the three profiles, which determine, at three different points, the desired contact within about fifty meters. This point of view of the experiment was of special interest, for no less than seven drill holes, distributed along a line about 1,100 meters in length, were needed to find the Calymene schists, and with them the iron deposits. This uncertainty is explained by the difficulty in distinguishing between the cores taken from the May sandstone, above the schists, and those from Armoricain sandstone, below the schists.

Conclusions—The experiments made in the Calvados show a way in which electrical prospecting seems capable of rendering service in the study of regions not containing good conducting ores. It is applicable only if the strata are tilted, and the indications are clearer as the beds become more nearly vertical. This is of advantage, as it is precisely in such examinations that the drill holes must be placed with the greatest precision. The following points must be noted: First, the facility with which the average strike of strata over a wide area may be determined; second, the possibility of following from place to place a known and conveniently chosen geological horizon.

It may be that the regularity of the Normandy Silurian, the considerable thickness of its beds, and the nature of the overburden constitute particularly favorable circumstances. I think that they are not isolated. Other and analogous conditions should be found in which the thin covering material would permit the rapid planning of a drilling campaign.

Study of the Form of a Conducting Body

Principles—Suppose a point of a conducting orebody is known, either by outcrop, or by any kind of exploration work, pit, gallery, or drill. Let it be, for example, a body Z of pyrite,[11] touched by a drill hole S at a point A, as is indicated in the plan and elevation of Fig. 23. To determine the approximate form of the deposit, the process is as follows: The contact B having been placed anywhere at a distance, the ore at A is chosen as the second contact, and the equipotential curves are traced at the surface of the ground, above A.[12] Because its conductivity is much superior to that of the surrounding ground, the orebody is at about

[10]The dots marked on the curves show the points determined in the field. Their positions were then noted in relation to the topography, and, finally, joined with a continuous curve in the drawing.

[11]Or a mass of magnetite, pyrolusite, or other like formation.

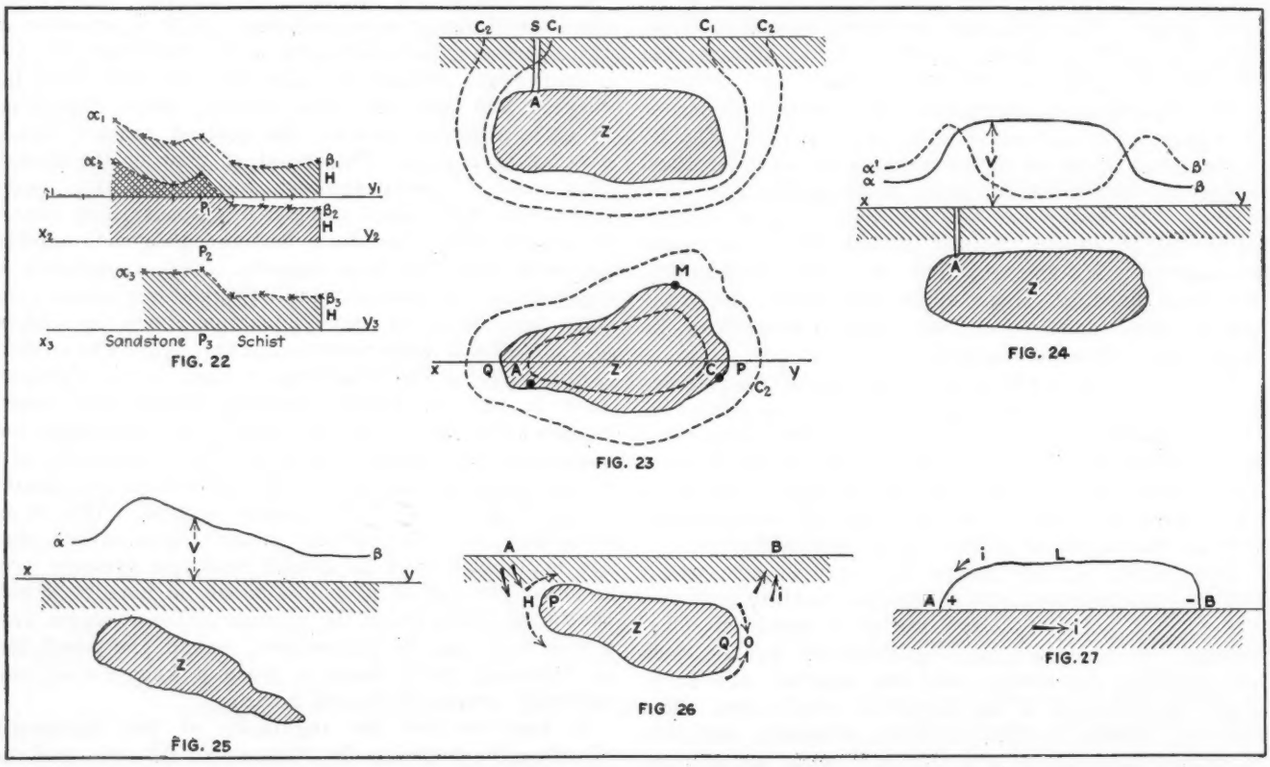
[12]If there are underground workings, the observations, which will permit the determination of the form of the equipotential surfaces in the ground, can just as well be made in them.

the same potential throughout its entire mass. The equipotential surfaces envelop it fairly closely, therefore, and their outcrops, following the lines C_1, C_2, are centered on the deposit[13] and follow its form more or less exactly.

To determine which of the equipotential, concentric curves coincides most nearly with the apparent horizontal contour of the mass, two features are distinguished. If, by means of work already done, one point M of the horizontal limit is known, a curve C_2, passing near the point vertically above M, is chosen as the apparent contour, admitting that it incloses the deposit at a practically constant distance. If nothing is as yet known, measures of potential above the mass are made. For example, a profile of potentials is laid out along a line xy, which cuts across the curves diametrically. As metrical, having a more abrupt slope on the side X than on the side of the dip, y. As a result, the equipotential curves will be more closely crowded at x than at y. Evidently, in practice it would be impossible to limit the mass precisely down the dip.

The practical difficulties come from: (1) The relief of the surface, which may cause notable perturbations; (2) lack of homogeneity of the soil; (3) accidents in the mass, such as faults, quartz dikes, and similar characteristics, which interrupt the electric conductivity, although the deposit is continuous from the miner's point of view.

From experiments at Bor (Serbia) upon a known mass of cupriferous pyrite, it seems possible to discover easily (in one or two days) the approximate form of a conductor of which a point has been reached, by



is represented in Fig. 24, the values V of the potential are laid out as the ordinates, with the surface of the ground as zero. Thus, a profile such as $\alpha\beta$ is obtained. The body Z being sensibly equipotential corresponds in the profile to a flat portion terminated by two zones where the potential falls rapidly, due to the considerable resistance drop which the passage of the current produces in the surrounding poorly conducting material. The limit of the deposit is taken at the points where this sudden drop is produced.[14]

The preceding is the simplest case, where the mass Z is nearly horizontal and distinctly limited by vertical sides. In general, the deposits have a more or less steep dip and taper out in ragged fringes without a well-defined horizontal contour. The potential-chart is then subject to more doubtful interpretation. Take the simple example of a dipping lenticular mass Z (Fig. 25). The profile of the potentials will not be symdetermining the equipotential curves around this point as contact. These conclusions would in any circumstance be invalidated if it were to be established that either the real form of the Bor deposit escaped me or that this mass constitutes an exceptionally favorable one that could not be found again, because of the nature of the ore and that of the incasing country rock.

I wish to add that the indications thus given refer to the form of the deposit in horizontal plane only, and that the vertical disposition (depth of the shoots and their locations) escapes discovery entirely, or nearly so, which is a grave disadvantage.

INDUCED POLARIZATION

A mass Z of metallic conductivity buried in the ground acts in the same manner as a bit of metal submerged in water. If a direct current, i, is passed between the two contacts A and B, as indicated in Fig. 26, it decomposes the water in the inclosing rocks. There results a deposit of hydrogen on the part P where the electricity enters the mass, and a deposit of oxygen over the entire region Q where the current

[13]The center is, in principle, the point where the deposit comes nearest to the surface, the apex.

[14]In practice the profile of potential is not traced, but a profile of the field H (or fall of potential per meter) is plotted. Thus a curve $\alpha'\beta'$ is obtained, in which the two maxima characterize the limits of the deposit.

leaves the ore. The polarization of the orebody is thus produced; that is to say, the orebody transforms itself into a veritable storage battery. As soon as the electrolyzing current *i* is turned off, this battery discharges itself through the ground (dotted arrows), *P* acting as the positive pole and *C* as the negative one. Observations at the surface of the potentials due to this discharge of current[15] should permit determination of the position of the conducting mass *Z*. The entire work is done with the usual apparatus already described (movable line, non-polarizing electrodes, galvanometer, and voltmeter).

Let it be said at once, however, that I have not as yet obtained really satisfying results in the field, but the difficulties which I encountered, on the other hand, enabled me to make two interesting observations. The first is that all pyrite deposits are spontaneously polarized and act permanently like great batteries, without there being any necessity to make use of an electrolyzing current. These forces of spontaneous polarization therefore hide, in the case of pyrite, the phenomena of induced polarization.

The second observation was of the following fact: When a current, *i*, is passed through any given ground between two contacts *A* and *B* in the direction from *A* to *B* (Fig. 27), on interrupting the current, by opening the circuit *L*, there remains for a certain time a residual difference of potential in the ground, the region around *A* remaining positive with respect to that around *B*, just as though the line *L* were continuing to discharge a small current in the original direction. These residual differences of potential do not exceed a fraction of a volt. They disappear progressively of themselves, the speed of dying out being the faster the shorter the length of time the current *i* was flowing. The same thing happens when using pure water instead of wet ground, provided that convection currents do not interfere by mixing the different parts of the liquid.

These phenomena are not caused by the surface polarization which takes place at the contact of the metallic pegs with the moist earth, but in a polarization of volume involving the entire mass of electrolyte around the contacts. There is not a simple diffusion in the ground of the oxygen and hydrogen disengaged at the metallic pegs, because the phenomenon is established instantaneously at a great distance; but the appearances are comparable to those that would be given by a battery containing gas thus formed. There seems to be a movement of ions which creates a dissymmetry between the two regions surrounding the electrodes *A* and *B*. The residual action is more intense and prolonged the stronger and more prolonged the current that provoked it, which appears to imply an electrolytic action.

SPONTANEOUS POLARIZATION

General—Studying the lens of pyrite of Sain-Bel, Rhone, in 1913, I noticed that near it the soil presented, spontaneously, easily measurable differences of potential.[16] This observation has been confirmed since, for pyrite deposits, by an entire series of investigations[17] in the course of which no exception was encountered. The fact may be considered as absolutely general as far as pyrite and pyritic minerals are concerned.

For veins of galena, differences of potential are observed when the ore contains pyrite (as at Villemagne, in the Gard); but it seems that the phenomenon does not exist, or at least is too feeble to be clearly observed, when pyrite is entirely lacking, as in the veins in the Penarroya district, Spain (mines of Villanueva de Duque).

I think that mispickel should be active, but have not had occasion to make conclusive field experiments with respect to that substance. Magnetite and pyrolusite give no results,[18] and it is the same for the non-conducting ores (blende, carbonates, and the like). Iron buried in the ground (pipes, rails and similar objects) on the contrary, causes phenomena analogous to those resulting from masses of pyrite.[19]

From this simple enumeration it may be concluded that the metallic conductivity factors in "spontaneous polarization."

Description of Phenomena Observed—Herewith is the manner in which these things are observed in a large lens of pyrite, such as that of Sain-Bel, of Bor, or of Andalousie:

When the soil is touched with a movable line containing a voltmeter and galvanometer and terminated by two non-polarizing electrodes, on approaching the deposit regular differences of potential will begin to be noticed several hundred meters away from the ore (300 meters, for example), the electrode nearest the lens being nearly always negative to the other. The difference of potential thus observed increases as one advances, and may even attain several millivolts per meter.[20] In the region above the ore the potential is nearly constant; then, after traversing the deposit, new differences are observed, but in the opposite sense from the preceding.

The results of these potential measures, usually made along a line, are easily translated into a profile in which the distances are laid out as abscissæ and the potentials as ordinates. The maximum of separation

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[15]These differences of potential should be weak. In fact, the total electromotive force of the battery should not exceed 1.5 volts, and, of this, a fraction only would be perceptible at the surface of the ground in the form of resistance-drop of potential of the discharging current.

[16]Since then I have searched for observations that may have been made on this subject by other authors. The first studies of electrical phenomena in metallic deposits were conducted from 1830 to 1848 by R. W. Fox, in the veins of Cornwall, using the decidedly rudimentary technique known at that period. (See especially Henwood, "Sur les courants electriques observés dans les filons de Cornouailles," Annales des Mines, 3d series, Vol. 11, 1837, p. 585; Reich, "Notix uber elektrische Strome auf Erzgangen," Annales de Poggendorff, Vol. 48, p. 287.) Then there must be mentioned the interesting observations collected by Carl Barus in 1880 at the Comstock lode and at the Eureka mine, which should have led their author to important results if he had not been handicapped by the imperfect apparatus in use at that time. Finally, in the laboratory, a number of experimenters have studied the polarization of various minerals in contact with different electrolytes. Among the works of this nature the most recent and most remarkable is that of R. C. Wells, "Electric Activity in Ore Deposits," U. S. Geological Survey. Bulletin 458, 1914. This publication contains a detailed bibliography of those works anterior to it.

To summarize the status of the question in 1914 I quote the last paragraph of the preface to the work of R. C. Wells, written by George Otis Smith, Director of the U. S. Geological Survey:

"It should be emphasized that results thus far obtained afford no adequate basis for any method of electric prospecting nor any promise of development of such a method by connecting the presence of ore deposits with readily or definitely measurable electric activity. Nevertheless, the data here presented are believed to possess value in the broader investigation of ores, for even feeble currents might exert a directional influence on ore deposition, and chemical conditions, even at a distance, might be a factor in determining mineral association."

[17]The list of the principal pyrite deposits studied is: Sain-Bel, Rhone (pure pyrite); Vaux, Rhone (magnetic pyrite); Saint-Felix-de-Pallieres, Gard (pyrite with galena and blende); Herrerias and Campanario, Andalousie (cupriferous pyrite); Bor, Serbia (pyrite and covellite).

[18]The experiments were made upon the magnetite of Normandy and upon the oxides of Romaneche (Saone-et-Loire).

[19]Thus it would be possible to find buried pipe lines as though they were pyrite deposits, except that the action is not so clear.

[20]The most marked effect noticed in this connection was a difference of potential of 400 millivolts in a line 100 meters long, making an average of four millivolts per meter (northwest border of the orebody of Bor).

between the summit of the line and the distant points may be as great as 500 millivolts. It is easy to trace the equipotential lines, and it will then be observed that they follow approximately the outlines of the deposit, surrounding a center of negative potential just above it. Moreover, there is frequently, in the wetter part of the deposit, a center of positive potential, of small extent, and naturally surrounded by the curves. Generally, the equipotential lines of spontaneous polarization close well, with about the same precision as the measures are made (several millivolts). They seem to be as stable as the profiles; that is to say, one finds them unchanged on making the measures over again after a certain time.

Application to Prospecting—Observation of the phenomena described seems, on first consideration, to be susceptible of rendering signal service in prospecting for various pyritic minerals. Their measurement requires only light apparatus, easy to handle; it is extremely rapid; and the action of the deposit is distinguishable at a considerable distance, at least for deposits that are of importance. Thus, it is possible to search the ground thoroughly, hectare by hectare, with a speed that I calculate to be, in favorable ground, at least twenty hectares per day, with two men, a prospector, and an assistant. As the work leaves no trace, absolute secrecy may be maintained, even with respect to the assistant, who does not see the instrument readings. Finally, where the region is indicated as interesting, it may be more thoroughly studied by means of the method of conductivities, which should permit, with or without drilling, the formation of an opinion concerning the importance and form of the deposit. All of this constitutes a tempting method of prospecting. Experience will show how much of this optimism is justified.

Two grave objections to the methods noted must be considered: First, pyrite grains disseminated in the rock may show polarization. It is thus that I encountered a long band of ground, giving in places notable differences of potential (200 to 300 millivolts), and which appeared to correspond to a series of schists strongly pyritized, although the exploration work has not yet disclosed them. How can one distinguish such a zone, lacking in interest for the miner, from a large deposit, compact and of great value? Certainly the general action of the phenomena, the accentuation of polarization at certain prominent points where the infiltration of water promotes the oxidation of the pyrite, should serve as a guide. Nevertheless, the hazard remains.

The second objection concerns the slight activity which even a virgin deposit, near the surface, might show. All the measurements I made (Sain-Bel, Bor, and at other places) were upon lenses already being exploited, or at least known by several galleries. It was, moreover, a condition necessary to enable me to ascertain if the results of my observations agreed with the reality. In a mine even slightly worked there are always infiltrations, and these cause an energetic oxidation. If this is the only cause of the phenomenon, it is probable that the polarization of new deposits, the only ones that interest a prospector, is of little importance, and falls to the magnitude of experimental error (ten to twenty millivolts). This is the more likely the deeper the mineral is buried in the ground and the more compact and impermeable the surrounding rock.

I summarize my present opinion as follows: Although at the beginning of the attempts I thought it possible to determine easily the importance of a deposit by the amplitude of its polarization, today I believe that a virgin deposit, or even one already developed, signals its presence by but localized polarization near its summit, and that will be perceptible only when the mineral comes near the surface (to within ten meters, for example), at least if the porosity of the soil and the position of the water table do not favor oxidation. Finally, one risks confounding a pyritic terrain with a deposit of massive pyrite.

For the exploration of ancient workings, prospecting by polarization would be excellent.

Evidence Obtained at Sain-Bel in 1920—At the moment of giving the order to print this work, I had occasion to make the following important observations on the Sain-Bel vein: At the southern extremity of the deposit, underground work, conducted during the war, encountered a small lens of good pyrite at forty and at fifty meters below the surface. This coincides exactly with the curves of spontaneous polarization, determined in 1913, and which present at this point a small negative center. The mineralization is fifty meters long. Its thickness, not yet known, seems not to exceed several meters. The pyrite probably comes close to the surface, but is hidden by the overlying soil, and so is invisible. These underground workings are two years old. They have not in the least modified the polarization of the ground, which was identical in March, 1920, with what it was in 1913. The water then seeping in through the galleries had no effect.

In résumé, these proofs show the possibility of discovering, by observation of spontaneous polarization, a virgin deposit of pyrite, provided it is not too deep.

CONCLUSION

It is not yet possible to be sure of the services that the various methods of prospecting described are capable of rendering in their present form. Certain conclusions cannot be made until after many experiments have been followed by exploration work. Nevertheless, the great adaptability and wide application of the methods discussed should be noted. There is reason to suppose that, among the innumerable problems presented by the mining industry, hydraulic researches, and studies of the earth's crust, certain ones will present themselves in a favorable manner, to be solved conveniently. I add, that the studies I have undertaken since November, 1919, and which are not explained here, have strengthened my previous optimistic opinion.

Electrical processes of prospecting will probably never give certain and precise results. Their domain is to furnish indications, serving as a guide for the orientation of researches by drill, shaft, or gallery. This rôle of auxiliary should be of interest. Underground work gives exact information upon the composition of the rocks traversed, but it does not explore, so to speak, more than a sole point of the deposit, and the deductions that are made therefrom have the disadvantage of being extrapolations; its execution is slow and costly. Electrical prospecting seems to present the opposite properties: lack of precision, but the possibility of studying wide space rapidly and economically, and of giving a view of the terrain in its entirety.

These opposite and complementary characteristics are affirmed at other points. The current reveals well the vertical heterogeneities (faults, veins, and tilted strata)

which escape drill holes so easily. It seems, on the other hand, to be nearly powerless to aid in the study of horizontal sedimentary strata (coal beds, potash deposits, and like formations), which the drills cut with a minimum of hazard.

As far as the depth attainable is concerned, I think that the electric method retains a wide field of application, even if the investigation beneath the surface is but of slight depth, not exceeding, for example, twenty meters. Many deposits or rock arrangements at present unknown are masked by only an insignificant covering of alluvium or soil, especially in equatorial countries or regions of only slight relief.

The present study constitutes merely a beginning. Perfections of detail and other analogous methods seem to merit serious investigation.

When one thinks of the formidable sums wasted every year in useless search, especially in metal mines, one hopes that important efforts will be undertaken to discover and perfect methods of prospection at a distance, even if their field of action be limited to depths of only a few meters.

Cooling and Humidifying Roaster Gases for Cottrell Treaters

At the tenth annual meeting of the Columbia section of the A. I. M. E., J. M. Schuettenhelm, metallurgist of the Bunker Hill smelter, at Kellogg, Idaho, described the steps which have been taken to secure a more efficient operation of the Cottrell treater at that plant. The blast furnace and lead refinery gases are freed of fume in a baghouse, but the gases from the Dwight and Lloyd sintering machines are too hot and contain too much sulphur dioxide to be handled in that manner, so the Cottrell process is used. The treater is of the downdraft type, has 256 pipes, 12 in. in diameter and 16 ft. long, and operates at 80,000 to 100,000 volts.

Owing to the lack of sulphur trioxide in the gas, it was necessary to cool and humidify it. Experiments showed that precipitation of the fume was best when the temperature was 110 deg. F. and the relative humidity 50 per cent, whereas the temperature usually varied from 200 to 300 deg. F. A large chamber was therefore built in which the gases could be sprayed with water. Short-circuiting troubles then developed. The insulators supporting the grid for the wires were originally outside the treater in sheet-iron boxes. In cold weather, moisture precipitated rapidly in these boxes, which, with the dust, formed a layer of mud on the insulators. This difficulty was solved by moving the insulators inside the treater and closing up the opening to the boxes.

All of the outside iron parts were also attacked by the moisture and gas, and the steel outlet flues rapidly corroded. These were replaced with wooden flues, and most of the iron doors in the treater were also replaced with similar wooden substitutes.

Owing to an enlargement of the plant, the volume of gases passing through the treater was found too great for efficient precipitation of the fume. Experiments showed that with the temperature and humidity constant, the fume precipitation varied with the gas velocity in the pipes. With a velocity of 7 ft. per second, practically all the fume would be precipitated in a 16-ft. length of pipe. If the velocity be higher, the remaining fume may be precipitated by passing the gases through another treater of the same size, providing the velocity of the gas is not more than twice the 7 ft. per second. Two such treaters could be operated in parallel, also, but the advantage of running them in series is in the cooling of the gas. If the temperature is not low enough in the first treater, it will be lower and the humidity higher in the second.

Alaska Noted for Its Gold Mines

During forty years of mining, the gold output of Alaska has amounted to $311,665,000, of which $218,000,000 is to be credited to the placer mines. The first notable impetus to gold mining in the territory was given by the discovery of the Nome placers in 1898 and by their rapid development, which reached its maximum in 1906. Meanwhile the placer gold from the Fairbanks district, which was first developed in 1903, helped to swell the output of gold to a maximum production in 1909.

Much the larger part of the placer gold recovered in these two fields, as well as in most other placer districts, such as Iditarod, Hot Springs, and Koyukuk, has been taken from relatively small and very rich or so-called bonanza deposits, rather than from larger bodies of gravel containing less gold. The production of placer gold has therefore been maintained by the exploitation of new bonanzas rather than by the installation of larger operations in the developed districts. Since 1911, however, there has been a gradual improvement in methods of mining, notably by the use of gold dredges, which have won gold amounting in value to more than $20,000,000.

A careful estimate, based on investigations made by the U. S. Geological Survey, indicates that the value of the placer-gold reserves of Alaska, including only those which have been adequately tested, is at least $360,000,000. The gold content of the gold-bearing quartz veins cannot be estimated, but the veins are widely distributed, and the outlook for the development of an auriferous lode mining industry is generally regarded as favorable.

Oils vs. Chemicals as Flotation Agents

Flotation practice in Australia and America is radically different, explained T. M. Owen in a short paper prepared for the A. I. M. E. recently. Here, there are any number of oils and oil mixtures to work with, but in Australia, the oil from the eucalyptus tree is practically the only one which is economically suitable for flotation purposes. As a result, experimenters in that country have built up their practice by the use of chemicals, which are aided in some cases by small amounts of oil.

As a general rule the use of chemicals increases the cost of flotation but produces cleaner concentrates. On this assumption, Mr. Owen suggested, as a general principle, that the use of oils should be stressed where gangue is not an undesirable element in the concentrates. Copper ores, as a rule, come within this class, as 10, 20, or 25 per cent of gangue material is not unwelcome. But where it is necessary to produce a relatively pure concentrate, such as is usually the condition with zinc and lead ores, careful and thorough tests should be made with many different kinds of chemicals, either alone or used in conjunction with oil, before concluding that the best commercial results are being obtained.

Marie Sklodowska Curie and the Story of Radium

BY DR. ROBERT ABBE
Senior Surgeon to St. Luke's Hospital, New York City

MARIE SKLODOWSKA'S father was professor of physics and chemistry in the University of Warsaw. She was born in that city on Nov. 7, 1867, and studied there until her graduation by the Gymnasium. The magnetic pull of the renowned Paris University, where science had its highest and purest atmosphere of research, brought her with scores of others from different countries to that institution.

Fired by the spirit of work, Marie Sklodowska was welcomed by Prof. Antoine Henri Becquerel in the Department of Physics, and by Prof. Pierre C. Curie in Chemistry, as a clear mind and a gifted student. The former permitted her to assist in his problem of uranium research, a search to see whether on exposure to sunlight its absorption would make it luminous.

An experiment was prepared with a photographic plate inclosed in a thick black paper. But the sun was hidden for a fortnight, and the plate with the piece of uranium was laid away in a drawer. Two weeks of dull Paris days passed. It was thought wise to test the freshness of the plate by developing it. To the surprise of all, a dark spot appeared beneath the mineral. Some unsuspected rays had gone through the black paper. This was the startling beginning of the discovery. "Becquerel rays" became the new wonder.

Mme. Curie herself took the next great step—the deciding step. She went to the mines near Carlsbad, Bohemia, where for a century the mineral pitchblende had been mined to extract the uranium. Pitchblende had long been known as a composite ore containing a dozen different elements in addition to the uranium. On examining the fifty tons of mine refuse, Mme. Curie found to her surprise that it was four times as strong in "Becquerel rays" as was the uranium extracted from it. The startling fact then stared her in the face, that something unknown existed in that refuse.

By chemical methods she proceeded to dissolve out all the lead and the other elements known to be present. With each succeeding elimination the quality of radioactivity appeared greatly strengthened. At last she obtained a small residue that could contain but two known elements, yet it was sixty times stronger than uranium itself. This remnant glowed in the dark. There could be but one conclusion: she was face to face with a mysterious, unknown force.

Two years later she was able, by ultra-chemical resources, with the help of her teachers and her husband (for Professor Curie had meanwhile offered himself and been accepted in marriage), to announce to the world in 1898 the demonstrated discovery of a new element—radium.

It was Marie Curie's beautiful tribute to science that an impersonal name "radium" was given, because the element emitted rays. Knowledge and not fame drew her. She industriously extracted all the radium from her small store, and after devoting another year to its study, offered it to the medical world.

In 1903 these first quantities of radium were released, and Americans were able to purchase the first morsel for New York. A quarter or more of that historic bit which proved that radium gives out heat continuously came quickly to America.

Mme. Curie's small store of the Bohemian refuse, however, was quickly exhausted, and all the radium to be had in the world was, for some time, made in Germany. That also we could buy, but at much higher prices.

It is the privilege of the women of the United States to choose this time to lay this tribute at Mme. Curie's feet—a gift of radium instead of a wreath of laurel—with which she can and will give back to them a thousand-fold in value, a hoped-for revelation of its medical power when its forces can be guided and directed to the cure, perhaps to the elimination, of that dread scourge —cancer—which she now intends to study.

With this essential aid to her further studies, Mme. Curie will return to France bearing also medals in gold

MADAME CURIE AT WORK

from the U. S. National Academy of Sciences, the Wolcott Gibbs medal of the American Physical Society, and other tokens that she will treasure with her Nobel prizes of 1903 and 1911. Before she leaves us, however, she will, on May 23, confide to the custody of the College of Physicians of Philadelphia, the original quartz-piezo-electric apparatus devised many years ago by Professor Curie and used by both herself and her husband in the earliest determinations of the radioactivity of the first radium salts they studied. The accompanying photograph shows Mme. Curie before a similar instrument. Her willingness to part with a cherished relic of her historic radium researches reveals her sentiments toward the country that honors itself by confiding its finest medical tool to her capable hands.

BY THE WAY

Prohibition Creek

Those intrepid explorers who go into the prospective oil region around Fort Norman, in northwestern Canada, this summer may wonder at the etymological reason for Prohibition Creek, should they happen to run on to that small stream. It was so named, said a speaker at the recent C. I. M. M. meeting at Montreal, because it was dry at the mouth.

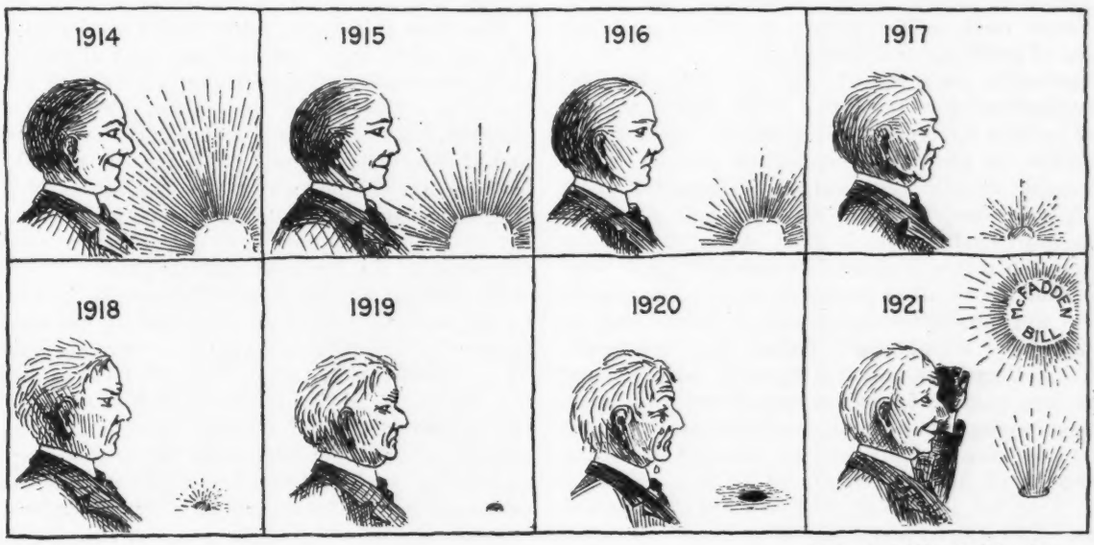
Petroleum the Pus of the Octopus

A correspondent sends us an oil report by Dr. J. M. Gregory of Arkansas. Apropos of the discussion concerning "Only a correspondence school mining engineer," our correspondent would like to know "What kind of a geologist is Dr. Gregory?" To which we reply, without hesitation: Dr. Gregory is a wonder. He is in the same class as Stephen Leacock, who wrote "Nonsense Novels"; or the author of "Bab Ballads"; or Lewis Carroll, who wrote "Alice in Wonderland"; or Frank Baum, who wrote "The Wizard of Oz"; only he heads the class. With difficulty we refrain from publishing his whole report: it is fascinating, exhilarating. We should like to publish his complete works. But we restrict ourselves unwillingly to his theory of the origin of petroleum, which is incorporated in this private report and also was published in the *Arkansas Oil and Mineral News* for Jan. 21, 1921:

> Petroleum is a product derived from vegetable and animal fats. All the vegetable and animal fats are used on the land until they serve the purpose they were intended to serve; but sooner or later they find their way to the little fish of the branches.
>
> The filth of the large cities, the carcasses found dead in the forest, in fact, all the refuse of the earth is washed down into the little streams and consumed by the little fish. And in time they are eaten by the larger fish, and in time they are eaten by the porpoises, sharks, whales, etc.: and in time the whales and such things are compassed about by the large parasites, generally called octopuses.
>
> After surrounding a whale with their numerous feelers they will retire to the bottom of the great waters. Sometimes it takes as long as twelve months to finally consume, by absorption, their victims. But everything has an end, and so do these great parasites. At their end and when their life is no more, and at a depth of about four thousand feet, they being a conservation of about ninety per cent fat: and it does not take long to become pus or oil.
>
> It is a fact that at a depth of about one thousand feet or more, in salt water, nothing rises to the surface: and the habitation of these mighty parasites being the bottom of the mighty ocean, naturally this rendered oil could not rise to the surface, owing to the salt of the salt water. Owing to the fact that the moon, by some mysterious force, controls the motion of the water, at the bottom of the deep, never-ceasing, everlasting finally puts the oil in motion, and being so pushed it finds its way out along the crevices of the rock, and along with it the salt water.
>
> If this theory of the manufacture of oil is not correct, then who is the man who can explain the presence of salt water in all oil fields?

Our Own "Main Street"

Participating in the great national indoor sport the other evening we took in one of the local "movie" palaces. Consistent with good advertising practice, the management includes, as a part of the regular program, a forecast of the features to be exhibited, showing a few hundred feet of each "feature"—obviously that portion which will appeal to the most lukewarm fan. Among these we saw "Colorado"—a Western mine thriller of the deepest dye. Slowly the descent was made in the realistic studio-prepared cage, the hero and his sweetheart clad in oilskins, of course, finally reaching the bottom of the mine shaft. A few flickers, and we see them in a drift—water dripping everywhere—and we fancy that our next view will be of the vein—native gold or some such thing. Suddenly, in the background a vast stream (estimated at 5,000 gal. per minute) issues from the side of the drift, rushes towards us, and envelopes John and Mary. The rest is left to our imagination, for at that moment we read that "the complete picture will be shown Wednesday and Thursday eve. and matinee." We count the hour not lost, however, for directly behind us sat a comfortable looking soul, who whispered to her husband, "Tell me, Will, why on earth are those two down in the sewer?"



By P. A. Robbins, San Francisco

MOVIE OF A GOLD-MINE OPERATOR CONTEMPLATING HIS INVESTMENT

CONSULTATION

Is Hardening Copper a Lost Art?

"Can you give me any information about the hardening of copper by heat treatment? I have assumed it to be a lost art, but recently have come in contact with a man who claims to be able to do it. Any information that you can give me on this matter or any references will be greatly appreciated."

We are indebted to E. E. Thum, associate editor of *Chemical & Metallurgical Engineering*, for the following information:

Copper, together with other ductile metals, may be hardened to a considerable extent by cold work. Thus, electrolytic copper as deposited has a Brinell hardness number of about 60, whereas hard-drawn trolley wire ordinarily has a hardness of 110. The hardness of ancient tools of copper and bronze is due mostly to this cause. Far from being a "lost art," ordinary bronze of today can be made as hard as any, in fact harder than most, bronzes of prehistoric times, by simple hammering alone. Dr. Petrie has also satisfactorily shown that the ancient Egyptian tools of copper, supposedly able to cut granite, were really metal holders for flints or other substances of great natural hardness.

The hardening property of iron has been held by many excellent scholars to be due to the fact that iron possesses certain allotropic modifications. That modification stable at ordinary temperature is soft, while another, stable at high temperature, is supposed to be hard. If, now, steel be quenched from high temperatures, the hard modification is fixed before it has time to revert to the softer modification stable at lower temperature, and the result is hardened steel. For copper to possess any analogous properties of hardening on quenching, copper would have to possess allotropic modifications, but Benedicks and also Burgess and Kellberg agree, as the result of precise experimentation, that pure copper possesses no such transformations.

Copper may also be hardened by alloying it with a small amount of another metal, or another chemical element. Zinc, tin, aluminum, and iron are the common additions. The alloyed metal should no longer be referred to as "copper," but should be named according to the chief alloying constituent. Copper with a sizable percentage of zinc is better known as brass; of tin, as bronze. Another favorite method of hardening copper appears to consist of so manipulating the melting—perhaps unwittingly on the part of the experimenter—that the resulting melt is impregnated with oxide. Cuprous oxide is soluble in molten copper, and alloys with it in exactly the same sense that metals do. Copper hardened in this way is considerably harder and more brittle than is the pure metal, but is unsuited for most of the purposes for which copper is used.

It is difficult to say whether there is any probability that a process of hardening copper, analogous to the processes now used when hardening steel, may at some future time be developed. If more was known about the real nature of steel-hardening, one might be able to prophesy with some degree of success. A late and interesting hypothesis leads to the belief that there might be possibilities along this line. I refer to the "Critical Dispersion" theory, which postulates that when a metal or alloy acquires relatively great hardness, it is due to the presence of a hard substance dispersed in the original crystals in what might be called a critical size and distribution. This dispersed material may be a pure metal or a compound. The particles must be scattered closely throughout the crystal, and act by interfering with that property—the ability to deform by the development of a few large slips—in two ways: first, they prevent the initiation of slips between crystalline layers as would billions of tiny staples in the leaves of a book; second, the slips, once started, despite this hindrance, do not get far, because of the internal friction against the little anchors. Thus the presence of these tiny particles, possibly crystals containing only a few atoms and therefore of ultramicroscopic or colloidal size, harden and strengthen the metal grains containing them by increasing the inherent capacity of a crystal for resisting change under external force. It is understood, of course, that plastic flow in a ductile metal takes place largely by development of relatively large slips along crystallographic planes in the metallic grains.

How does this theory apply to the hardening of steel? We are fairly sure, for instance, that at ordinary temperatures mild steel consists of crystals of pure alpha iron and crystals not of carbon, but of a chemical compound between iron and carbon which has been named cementite. Now, if this steel is heated to about 900 deg. C., the alpha iron absorbs the carbide cementite, which appears to diffuse itself uniformly throughout the iron—it actually goes into solution, even though the metal is far from its melting point. The resulting solid solution has been called "austenite." If this austenite be cooled, the tendency is for the cementite to reappear in crystals, observable under the microscope. This is because it is insoluble in iron at lower temperatures. However, if the cooling is relatively rapid, the accumulation of carbide particles is not large enough to become visible under the microscope; in other words, the tiny crystals of insoluble cementite are submicroscopic. As iron carbide is much harder than the crystals of iron, the result is an intense hardening of the resulting alloy, caused by a relatively small amount of carbon, existing not as carbon but as a hard chemical compound with iron.

Now, it is not inconceivable that at some time in the future some chemical compound will be discovered which is quite hard, and which is soluble in copper at a high temperature and less soluble at a lower. When this compound is found and introduced successfully into the metal, a heat treatment analogous to that for steel will produce a true hardened copper.

Such a thing has actually been done for aluminum. The new alloy called "Duralumin," which was used with such great success for airplane parts, and is now being adapted to light metallic manufacturing where strength is required as well as lightness, may be hardened by virtue of the fact that the small amount of copper in the aluminum forms a compound $CuAl_2$, which is more soluble as the temperature rises. Quenching at a correct rate allows this then-insoluble material to accumulate in the correct sized particles, and hardness and great strength result.

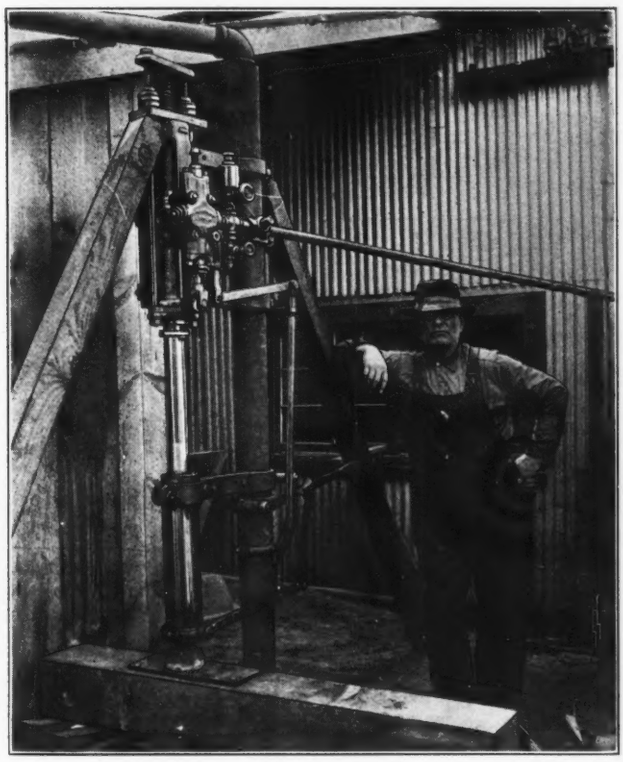
HANDY KNOWLEDGE

Shop Hammers

Written for *Engineering and Mining Journal*

In most mine blacksmith and tool-sharpening shops small compressed-air hammers are used. The usual arrangement is a piston drill with the rotating mechanism removed and mounted upon a vertical standard. The valve is controlled by a foot lever, and the force of the blow is regulated by the air valve. As a rule, the length of stroke cannot be varied.

Andrew Riley, master mechanic of the Plymouth Consolidated Gold Mines, Ltd., at Plymouth, Cal., recently devised a shop hammer which utilizes the control used



LENGTH OF STROKE AND FORCE OF BLOW CAN BE CLOSELY CONTROLLED IN THIS SHOP HAMMER

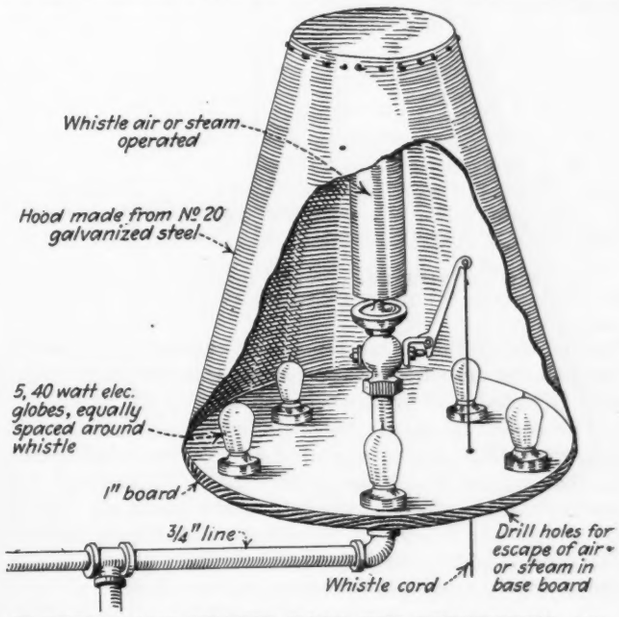
upon the steam hammer and makes possible close control of the length of the stroke and the force of the blow. The arrangement is clearly depicted in the accompanying cut, which shows the hammer and its valve-driving mechanism. The hammer shoe is replaceable, and is held in a heavy hammer head which passes through the guide shown just above the operating handle. This guide contains a feather which projects into a feather-way in the hammer head, thus preventing the reciprocating parts from turning on their vertical axis. The operating lever can be clamped at any position upon the sector by a wing nut and bolt. The hammer operates smoothly, and the force of the blow is controllable from nothing up to the maximum possible with the air pressure. Mr. Riley is shown in the photograph standing by his latest novelty.

Preventing Air Whistles From Freezing

By Roy H. Poston

Written for *Engineering and Mining Journal*

Small air and steam whistles used for signal purposes around mines may be kept from freezing in moderately cold weather by means of an electrically heated hood. No attention is required beyond that of keeping good


Whistle air or steam operated
Hood made from No. 20 galvanized steel
5, 40 watt elec. globes, equally spaced around whistle
1" board
3/4" line
Whistle cord
Drill holes for escape of air or steam in base board

ELECTRICALLY HEATED HOOD FOR PREVENTING AIR WHISTLE FROM FREEZING

globes in the sockets at all times. The sound is, of course, somewhat deadened, but it may easily be heard by the hoistman, if the whistle is properly placed.

Power Threading of Pipe

Written for *Engineering and Mining Journal*

A power device for threading pipe from two to four inches in diameter was rigged up by E. S. Teal at the

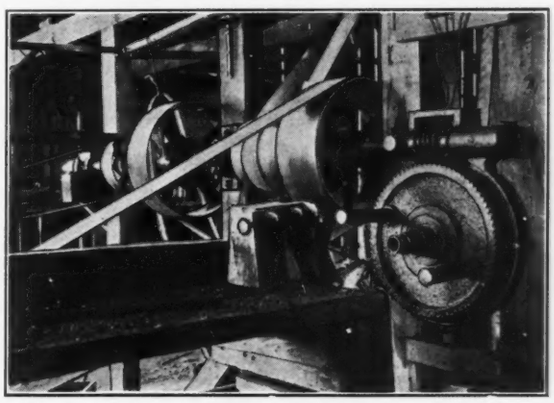


FIG. 1. POWER DEVICE FOR THREADING PIPE

Darrow cyanide plant near the Argonaut mine, at Jackson, Cal. A similar device could be extemporized where

there is a large amount of such work to be done, and its use would save time and labor. The arrangement at the Darrow plant consists of a worm gear, ratio 1:80, supported in a vertical plane and driven from a countershaft. To use it, a pipe is supported on a vertical post placed on one side of and at the height of the center of the large gear wheels. This post can be moved to a

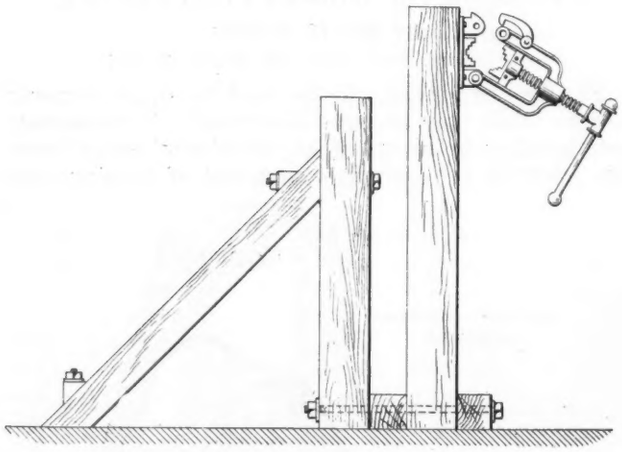


FIG. 2. VISE USED WITH POWER DEVICE FOR THREADING PIPE

limited extent in an arc lying in a vertical plane parallel with the gear wheel. To permit this, the foot of the post is bolted as shown in Fig. 2.

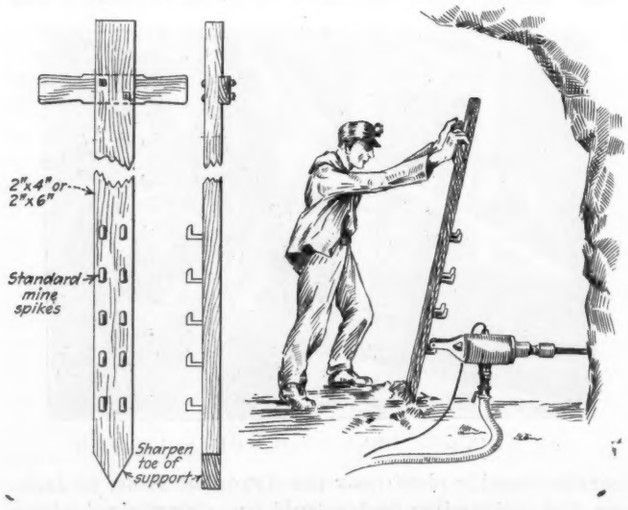
The pipe vise is of the ordinary hinged type. The pipe-threading dies are rotated by the two pins shown in the face of the large gear, Fig. 1. Bushings are screwed on the shaft of the gear and support the end of the pipe while it is being threaded. A bench to support the pipe is shown in Fig. 1. The pipe is held in its proper position on the bench by wooden blocks.

Support for Hammer Drills

BY ROY H. POSTON

Written for *Engineering and Mining Journal*

The device shown in the accompanying illustration may sometimes be used to advantage when drilling with hammer drills. The drawing is self-explanatory and shows only one dimension, that of the support itself, for obvious reasons.



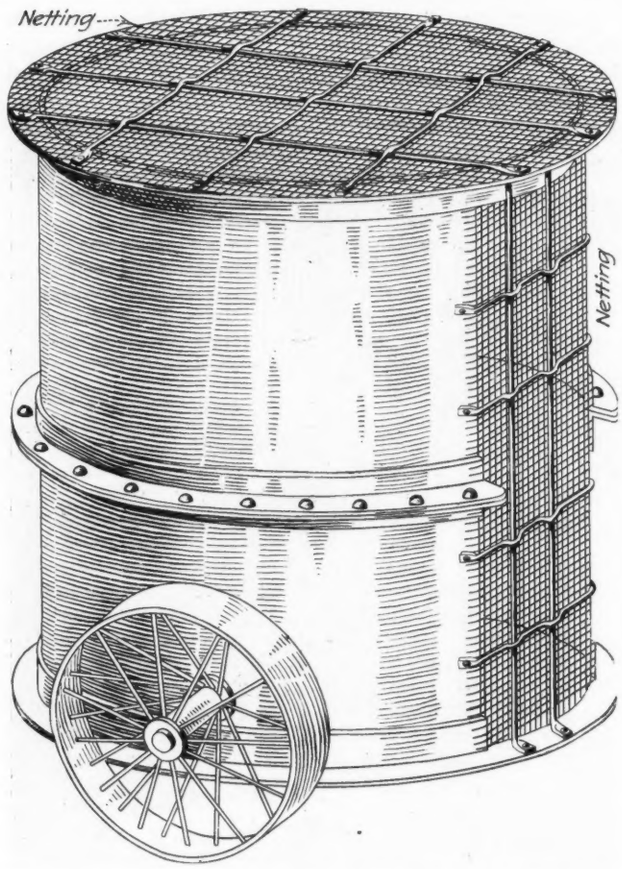
MAKESHIFT SUPPORT FOR HAMMER DRILL

A Safeguard for Surface Blasting

Written for *Engineering and Mining Journal*

A blasting "tank" which was used when putting through an approach to the Missabe Mountain mine of the Oliver Iron Mining Co. at Virginia, Minn., is illustrated herewith. The cut was near one of the company's locations, and it was decided that if proper care were used the work could be done without inconvenience or danger to the tenants.

The ground was composed principally of glacial till, which ordinarily offers little resistance to the steam shovel. Most of the work, however, was done in the winter, under extreme temperature conditions, and as the frost extended to a depth of six feet in places, it was necessary to drill blasting holes ahead of the shovel.



BLASTING "TANK" FOR SAFEGUARDING SURFACE WORK

Before blasting the tank was rolled over the holes, which prevented frozen chunks, small boulders, and dirt from being thrown.

The tank, which was mounted on iron wheels, was made from one of the blasting or shelter houses used in open pits on the Mesabi Range to provide safety for the men. They are circular in shape, made of steel plate, provided with a conical roof, and are ordinarily placed at various points so that workmen may take refuge in them during blasting. To convert the shelter into a blasting tank the conical top was removed, quarter-inch-mesh iron screen substituted for it and 1½-in. bars were bolted to the outer rim. Similar bars, threaded and bolted on the outside, were placed about a third of the way down from the top, these serving to reinforce the tank. Screening, also reinforced, was placed over the entrance of the former shelter.

THE PETROLEUM INDUSTRY

The Oil Bore at Roma, Queensland

SPECIAL CORRESPONDENCE

Efforts to remove an obstruction, at a depth of 3,705 ft., in the state oil prospecting drill hole at Roma, Queensland, have been continued, but so far without success. Two attempts were made to raise the obstructing tools by attaching them, by means of a casing spear, to the casing (first to 6-in. and afterward to 8-in. tubing) and forcing the tubing upward. The first effort raised the obstruction three feet, when the 6-in. casing broke. When a greater strain was applied, the stouter tubing also broke off just above the jammed tools.

During an outburst of gas in the bore some months ago, the escaping gas forced the broken bit and stem upward 450 ft. from the point at which they had jammed, and it is now proposed, as a last resort, to release the gas, which has since been brought under control, in the hope that the obstruction may be forced further up the hole and possibly be removed altogether. If this fails, it is probable that attention will be given to a scheme for the utilization, on a commercial basis, of the gas and its petrol contents.

March Petroleum Production Greatest Ever Recorded

During March the United States produced, according to the U. S. Geographical Survey, the greatest quantity of petroleum ever recorded for any one month, amounting to 40,802,000 bbl., and, although the daily rate of consumption increased slightly, stocks of crude oil were increased by more than 8,000,000 bbl. The daily average production of 1,316,193 bbl. increased 53,765 bbl. as compared with February, and 160,354 bbl. as compared with March a year ago. For the first quarter of 1921 preliminary figures show a production of more than 114,000,000 bbl., which is an increase of over 11,000,000 bbl. as compared with the first quarter of 1920. Substantial increases in daily average production during March are reported for Oklahoma, Texas, California, and Kansas, and smaller increases are recorded for Illinois, West Virginia, Kentucky, Pennsylvania, New York, and Colorado. Decreased daily average production during the month is reported for Louisiana, Wyoming, Montana, Ohio, Indiana, and Tennessee. Ten thousand barrels are reported as having been received at refineries from Arkansas during March, which constitutes the first commercial shipment of petroleum from that state.

Imports for March, amounting to 12,303,114 bbl., show a falling off in daily average as compared with February of 9,705 bbl. However, for the first three months of the year imports increased more than 19,000,000 bbl. as compared with the similar period of 1920.

Stocks of all grades increased, except North Louisiana and Rocky Mountain grades, the gains being distributed as follows: Net pipe-line and tank-farm stocks east of California, 5,650,000 bbl.; California grades, 1,330,000 bbl.; and Mexican petroleum held in the United States by importers, 1,049,000 bbl. Since the first of the year stocks have increased more than 17,000,000 bbl.

The accompanying figures, compiled from company reports to the U. S. Geological Survey, show the quantity of petroleum removed from producing properties. Oil consumed on the leases is not included. This item and net changes in producers' stocks at the beginning and end of the year are obtained by annual canvass and are included in the final statistics of production. Oil consumed on the leases is not included.

Cat Creek Field Production Increasing

SPECIAL CORRESPONDENCE

The thirtieth producing oil well has been brought in in the Cat Creek field, in central Montana, and ten more are expected within the next month. The construction of a second pipe line to the Cat Creek country is nearing completion. This will be a six-inch system, as compared with the present four-inch line. About twenty railroad carloads of oil are being shipped daily from the Cat Creek field, but this amount now is being increased in consequence of an increased demand recently.

PETROLEUM PRODUCED IN THE UNITED STATES IN FEBRUARY, 1921, MARCH, 1921, AND MARCH, 1920

(Barrels of 42 U. S Gallons)

State	February, 1921 (a)		March, 1921		March, 1920	
	Total	Daily Average	Total	Daily Average	Total	Daily Average
California (b)	9,184,000	328,000	10,482,000	338,129	8,570,000	276,452
Central and Northern Texas	5,774,000	206,214	6,692,000	215,871	5,405,000	174,355
Coastal Texas	2,566,000	91,643	2,980,000	96,129	1,868,000	60,258
Oklahoma	7,919,000	282,821	9,602,000	309,742	8,689,000	280,290
Kansas	2,478,000	88,500	3,005,000	96,936	3,328,000	107,355
Northern Louisiana	2,172,000	77,572	2,128,000	68,645	2,546,000	82,129
Coastal Louisiana	156,000	5,571	165,000	5,323	152,000	4,903
Wyoming	1,497,000	53,464	1,614,000	52,065	1,316,000	42,452
Illinois	785,000	28,036	963,000	31,064	993,000	32,032
Kentucky	695,000	24,821	779,000	25,129	719,000	23,194
West Virginia	634,000	22,643	756,000	24,387	766,000	24,710
Pennsylvania	603,000	21,536	672,000	21,678	666,000	21,484
Central and Eastern Ohio	427,000	15,250	466,000	15,032	449,000	14,484
Northwestern Ohio	175,000	6,250	193,000	6,226	192,000	6,193
Indiana	92,000	3,286	101,000	3,258	73,000	2,355
Montana	115,000	4,107	97,000	3,129	8,000	258
New York	66,000	2,357	86,000	2,774	81,000	2,613
Arkansas (c)	.....	.....	10,000	322	.....	.....
Colorado	9,000	321	10,000	322	9,000	290
Tennessee	1,000	36	1,000	32	1,000	32
Totals	35,348,000	1,262,428	40,802,000	1,316,193	35,831,000	1,155,839

(a) Revised. (b) Average of figures reported by Standard Oil Co. and Independent Oil Producers' Agency. (c) Figures from Arkansas include only tank-car shipments to refineries.

Book Reviews

Industrial Oil Engineering. By John R. Battle. Flexible cloth; 5 x 7½; pp. 1,131. J. B. Lippincott Company, Philadelphia, Pa. Price, $10.

This book is divided into eleven sections, with marginal index so that they may be readily found. The subject matter has necessarily been collected from a variety of sources, such as the various U. S. Government publications, engineering society papers, and other reliable data. The first nine sections are devoted to the more general aspects of oils, whereas Section 10 considers the various uses in detail.

Section 1 is devoted to mathematics and useful data, and is similar to that found in almost every handbook. Section 2 deals with marketing and transportation methods. Mechanical Engineering is the title given to Section 3, which includes numerous tables, short descriptions of steam engines and turbines, use of the indicator, and a brief discussion of the most common electrical terms. Petroleum and its products are dealt with in Section 4, information being given on refining and manufacturing processes.

Fats and oils other than petroleum products are considered in Section 5, and their characteristics and uses are briefly outlined. Section 6 is devoted to the testing and properties of oils, and describes in detail the methods and instruments used in making the various commercial tests. Section 7 deals with lubrication and friction and describes the various types of bearings, together with the proper systems of lubrication for each. Comparative tests on babbitt, roller, and ball bearings are given. The equipment for properly using and storing oil is discussed in sections 8 and 9, and includes descriptions of filters and reclamation and cooling processes, together with storage systems and handling.

With this comprehensive introduction Section 10, of 500 pages, is more readily understood. The various uses for oils of every description are arranged alphabetically and cover an almost unbelievable range of subjects from Air Compressors and Automobiles, through Core Binders, Cutting and Drilling Operations, Flour Mills, a very good division on Heat-Treating Processes, Marine Engines and Oils, Printing Plants, Rust Prevention, Shoe Factories, Textile Operations, Steam Turbines, and finally a division on Water Wheels. Though this list contains only a few of the subjects considered, it will serve to reflect the scope of the section.

The last section, 11, is devoted to Industrial Oil Specifications, and discusses lubrication costs and reports, together with U. S. Government specifications for various grades of lubricants and motor gasolene. Last, but by no means least, is a very complete index covering sixty-five pages.

In each subdivision of Section 10 is a blank form to be used for listing the names, prices, and specifications of oils which have been found suitable for the parts under consideration. Another feature, possibly unintentional, is the blank space on many of the pages below the text. These form convenient places for notes.

The subject of liquid fuel is only briefly discussed, but the author announces in the preface that an additional section, covering this important subject, is now being prepared.

The print is clear and legible, the illustrations, drawings, and curves are many and good, and the subject matter is generally well arranged, so that this should prove a valuable work for those interested in oil in any of its numerous uses. **T. M. R.**

Handbook of Mexican Properties and Securities. Compiled by J. S. Curtiss. Paper; 6 x 9; 350 pp. Published by J. S. Curtiss & Co., El Paso, Tex. Price, $5.

This book will be valuable to all of those who are interested, either as investors or operators, in Mexican mining or agricultural properties. The list of mines is arranged by states and seems to be complete. In general the officials are given, together with a short description of the property, including its capitalization and brief mention of the securities issued. Another extensive list gives the names of the proprietors of all of the ranches in Mexico, together with their addresses. Several pages are devoted to the mining laws of Mexico and to the new constitution of that country. A dictionary showing the American equivalents of the Spanish mining terms is an attractive feature.

Glass Sands of Kentucky. By Charles H. Richardson. Cloth; 6 x 9; pp. 145; 23 illustrations. Kentucky Geological Survey, Series 6, Vol. 1, Frankfort, Ky., 1920.

Though the glass-sand industry of Kentucky is small, the report shows that excellent sands, together with other important glass constituents such as lime and fluorspar, are available, and also natural gas for fuel. The author visited sixty-six glass factories to obtain authentic data on manufacturing processes and raw material requirements. The first sixty-seven pages of the book contain a discussion of the properties, history, classification, raw materials, colorizers and decolorizers of glass, the preparation of sand, and processes of glass manufacture. Forty-one pages are devoted to descriptions of sand deposits in Kentucky, and twenty-seven pages of analyses. A summary and glass-sand bibliography follow.

The concise discussion of the glass industry is a commendable feature of a work on glass sand. The book is to be regarded as a valuable addition to the literature of this important and somewhat neglected subject. **O. B.**

Technical Papers

Drill Steel Standardization—The *Bulletin* of the Institution of Mining and Metallurgy for February, 1921 (No. 1 Finsbury Circus, London, E. C. 2, England), contains twenty pages of discussion of the paper recently presented by E. A. Wright on "The Standardization of Materials Employed in Mining and Milling Plants." Most of the discussion was on the subject of drill steel, but lack of data prevented the reaching of any definite conclusions.

Oil—A preliminary report by Robert W. Ellis, professor of geology in the State University of New Mexico, and State Geologist, entitled "The Oil Situation in New Mexico," outlines the result of a series of reconnoissance trips made by the author during the summer of 1920 for the purpose of securing data on the conditions having to do with oil production in the state. Oil prospecting has been of recent date, and up to the time of the report about fifty wells had been started. None of these can be said to be producing, although some have produced a few barrels for a limited time. It is stated that the Seven Lakes region in McKinley County has become the most encouraging field. The geology of several counties is reviewed and a summary of explorations in each is given.

Phosphoric Acid Determination—J. E. Clennell gives the details of an improved practice which he has developed for the estimation of phosphoric acid by the molybdate method in the *Mining Magazine* for March (Salisbury House, London Wall, London, E.C. 2; price, 1s 6d.; 3 pages).

Alaska—Bulletin 714-B, of the U. S. Geological Survey, Washington, D. C., eighty-two pages, obtainable upon request, contains chapters on lode mining in the Juneau and Ketchikan districts; the Salmon-Unuk region; and water-power investigation in southeastern Alaska.

Mining Costs—"Notes and Records of Mining Costs" is the topic of a seventeen-page paper in the March *Bulletin* of the Institution of Mining and Metallurgy. (No. 1 Finsbury Circus, London, E.C. 2; price, 1s. 6d.) The data cover operations in the Witwatersrand gold fields of South Africa and give detailed costs for the Simmer & Jack Proprietary Mines, Ltd. Reasons for varying costs are carefully detailed, and the method of applying general principles of cost analysis is explained.

Idaho Mineral Resources—U. S. Geological Survey Bulletin 713, 152 pages, obtainable upon request to the Survey at Washington, D. C., is descriptive of the geography, geology, mineral, and water resources of the Fort Hall Indian Reservation, Idaho. The principal minerals are phosphate rock and placer gold.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Copper Producers Must Take More Interest in Marketing, Says Walter Douglas

Legislation To Permit Stabilization of Prices of Refined Copper Also Held To Be Advisable

More intimate co-operation between copper producers, fabricators, and marketing agencies, and a modification of the Sherman and Clayton acts so that a combination of producers could be formed with the purpose of stabilizing prices were the two methods proposed for improving the copper industry, by Walter Douglas at the regular monthly meeting of the New York Section of the A. I. M. E., at the Machinery Club, Wednesday night, May 4. Mr. Douglas is president of the Phelps Dodge Corporation. Other speakers included Edwin Ludlow, president of the A. I. M. E.; S. D. Warriner, president of the Lehigh Coal & Navigation Co., and C. E. Lesher, editor of *Coal Age*. The subject for discussion was "Lessons to Be Learned From the Present Depression in the Mining Industry."

Although President Ludlow had not expected to be called on to address the meeting, his short opening talk was particularly well received and was much to the point. Mr. Ludlow spoke of having just returned from a trip through the West. Everywhere, he said, a higher tariff on the material in which local interest centered seemed to be the one thing most desired. In the Northwest an increased duty on lead was the sine qua non; in Tulsa, Okla., a duty on crude petroleum was considered necessary to protect local producers from Mexican competition. Mr. Ludlow, however, felt little sympathy with these purely local and selfish ideas, and thought that the good of the country as a whole should be considered first. He said, "I cannot see that building a tariff wall around the country is going to help matters much." Foreign nations cannot pay their debts to us in cash; the only way is by the work of their hands. Our goods must be exported, and must generally be paid for by the importation of manufactured articles.

Walter Douglas first took up the question of how the producers could have prevented the present copper depression. He explained that the United States Government had given instructions to produce copper at the maximum rate during the war, and that these instructions continued in force for two months after hostilities ceased. About 700,000,000 lb. was produced or in process of transit when curtailments were finally permitted. Then the producers, in an effort to gage future requirements, tried to estimate the amount of secondary or scrap copper available. It was almost impossible to obtain any information of value on this point, so they had to guess and guessed low. They also did not count on the long delay in the peace negotiations, which has postponed the rehabilitation of Europe, and the great depreciation in foreign exchange which has acted to prevent foreign buying. Although 100,000,000 lb. less copper was produced in 1919 than in 1918, still the market was flooded.

The history of the copper market in the United States was then developed by Mr. Douglas, who went back to Civil War days. Two or three attempts had been made to regulate production and prices, the last in the late 80's, but all were short-lived. The dependence of the copper industry on export demand for prosperity was emphasized. A major defect in the present marketing scheme was held to be the fact that producers do not reach the ultimate consumer. By the time copper reaches the public four or five profits have been added. This is something which has been called to the attention of readers of the *Engineering and Mining Journal* in numerous editorials. Mr. Douglas mentioned these, and said that to the extent that they laid the blame on the original fabricator he thought they were unfair, as the blame should rest on the jobber and distributor.

Copper producers can derive consolation, said Mr. Douglas, from the fact that producers have taken steps to curtail, and also that no new ore deposits of importance have been discovered in the last ten or twelve years. There is a big potential demand in Europe.

In summing up the subject Mr. Douglas spoke of the publicity campaign which is now being formulated to advertise the merits of copper to the ultimate consumer, and recommended that producers follow the copper more closely through fabricating and marketing channels, rather than lose all interest in it the moment the crude product is sold. The extreme price variation is also a detriment to the industry, and some method of stabilizing prices at a fair figure would be of great economic benefit. To do this existing legislation would have to be so modified that producers could act in unison. It is not right, said Mr. Douglas in closing, that Europe should be able to denude us of our natural resources at less than cost.

Colorado Scientific Society held its 342d regular meeting on April 30, 1921, at Denver, Col. The members heard Arthur J. Hoskins speak on the treatment of oil shale. On May 7 he discussed its commercial features.

San Francisco Section, A. I. M. E., Hears Committee Report

Rigid Economy Urged on Institute—Decentralization Favored—Monthly Journal Rejected

Sidney J. Jennings and Charles W. Goodale surprised the members of the A. I. M. E. section at San Francisco, Cal., by dropping into the meeting on April 26 at the local Engineers' Club. About forty members were present, and as the subject of the business meeting was the final report of a committee on the locally discussed subject of the publication *Mining and Metallurgy*, the visitors from beyond the Sierras were treated to a lively time. The committee's report was accepted as read with the exception of that part recommending the continuance of *Mining and Metallurgy*. By a majority vote the section expressed disapproval of *Mining and Metallurgy* in its present form and recommended its discontinuance.

The other important recommendations of the committee, adopted by the section, were:

Rigid economy so far as is consistent with good service should be practiced in the conduct of the Institute's affairs, and with this end in view your committee approves the plan which has been suggested for a classification of publications. Such a plan would enable each member to choose such publications as he might desire and thereby materially reduce the total expense for publication and distribution. A more careful system of editing, also, should result in the elimination of much material which for various reasons ought to be published in the *Transactions*.

For the purpose of securing a more democratic and decentralized system of government for the Institute, we approve the suggestions made by former president Hoover that the constitution be so amended as to make the chairmen of the local sections automatically members of the Institute Board of Directors. . . .

In view of the wide distribution of the sections and the distance which separates many of them from the headquarters in New York, we suggest that once a year a directors' meeting be held, to which the most important questions regarding the Institute's policies should be referred, and that an attempt be made to have present a representative of each section, even though the expense of such attendance must be met in whole or in part by the Institute or its local sections.

At the conclusion of the business meeting, Gerard B. Rosenblatt presented an interesting paper on "Haulage for Metal Mines of Moderate Size." His discussion bore particularly on the conditions favoring the adoption of trolley locomotives, and those under which the storage-battery type is preferable. An abstract follows on p. 832.

"Mining and Metallurgy" Favored by Several Sections

A recent letter from Secretary Bradley Stoughton states:

"The president and the secretary recently discussed with the local sections of the Institute of Mining and Metallurgical Engineers the magazine *Mining and Metallurgy*, with the result that in every case the sentiment was overwhelmingly favorable to the magazine. In four cases where votes were taken the expressions of opinion were unanimously in favor of the magazine. I am giving below the sections in question and the approximate number of members taking part in the vote.

"Puget Sound Section, about twenty present; Oregon Section, about thirty present; Columbia Section, about twenty present; Montana Section, about seventy present; Minneapolis-St. Paul Section, about twenty-eight present; Chicago Section, about twenty-five present."

Minnesota Engineering Societies Organize a Federation

After a year of effort, the engineers of Minnesota have effected a federation of the leading engineering societies of the state. A constitution and by-laws, drawn up by a joint board appointed by the representative meeting held in June, 1920, was submitted to and ratified by the ten organizations seeking membership. A meeting held on March 11, 1921, in St. Paul, Minn., took final action to complete and perfect the federation.

The ten societies of the federation are: the Minnesota Surveyors and Engineers' Society; Minnesota Chapter, American Institute of Architects; Minnesota Chapter, American Society of Heating and Ventilating Engineers; Northwestern Section, American Society of Civil Engineers; Engineers' Club of Minneapolis; Engineers' Society of St. Paul; Minnesota Section, American Institute of Electrical Engineers; Minnesota Section, American Society of Mechanical Engineers; Engineers' Club of Northern Minnesota; Duluth Engineers' Club.

It is expected that each individual society will seek membership in the Federated American Engineering Societies.

Course in Mineralogy by Mail For Prospectors

Professor A. S. Eakle, of the University of California, is conducting a course in determinative mineralogy for prospectors and others to whom such instruction is of practical advantage. The course is conducted by correspondence, and teaches simple, practical methods for identifying minerals.

The necessary apparatus, 100 specimens and a textbook are supplied. The course is of university grade, and is offered by the University Extension Division of the university, 301 California Hall, Berkeley, Cal., to which address all inquiries should be sent.

Electric Haulage in Small Mines Offers Many Advantages

Superior Flexibility, Simplicity, and Reliability Bring Cheaper Operation —Cost Per Ton of Ore Hauled Governs Choice of System

Gerard B. Rosenblatt addressed the San Francisco Section of the A. I. M. E. meeting on April 26 on the subject of "Haulage for Metal Mines of Moderate Size." His remarks were reported in full by our correspondent, and the following condensed version has been prepared from that report:

The selection of the proper system of haulage for the metal mine of moderate output—500 to 2,000 tons of ore per twenty-four hours—deserves more careful consideration than is generally accorded it. The advantages of mechanical haulage are widely recognized, but a cost analysis of the various systems available is not generally made before deciding upon the type that will be installed. First cost is frequently given more or less careful consideration, but factors affecting the cost of operation are often overlooked.

This is not a brief for electric haulage, but I believe it will be admitted that on account of the flexibility, reliability, and comparative simplicity of electric locomotives this form of mechanical haulage will prove most applicable in the majority of operations. Gasoline locomotives and compressed-air locomotives have their particular fields of application, but these fields are rather limited. The proper field of the gasoline locomotive is for small tonnages over comparatively long distances on temporary work under conditions where it is more important to keep low the total initial investment than to secure continuity of service or economy of operation and maintenance. The particular field of the compressed-air locomotive is for large tonnages over long hauls where conditions necessitate heavy trains, but where the physical surroundings prohibit the installation of a trolley or third rail. For all other conditions electric haulage can be proved to be superior.

In selecting haulage equipment the primary consideration is that mechanical haulage is installed to help the mine make money. It makes money by saving expense. The type, size, and make of equipment that will handle a given output and will save the most expense is the logical type to install. The haulage system should not be selected on the basis of lowest first cost alone, nor should it be selected on the basis of some individual's preference. First cost and personal preference are factors entering into the problem, but they are neither the only nor even the predominating considerations. Haulage installation should be made on the basis of a complete logical analysis. And the foundation of such analysis should be cost per ton of ore hauled.

Upon the reliability of its component parts depends the continuity of service that the haulage system will render. Interruptions mean money lost. Delays in continuous service are expensive. A locomotive out of service for repairs, a train held up on account of a trolley wire down, mean money going out and none coming in. It is not just the expense of putting the locomotive back in service or of stringing up new wire that must be considered—it is interest going on, ore piling up in the chutes, and perhaps it is even reducing the mill output. Haulage equipment should be selected so that for the particular conditions time out of service will be a minimum. To do so will reduce the costs per ton hauled by keeping up the tonnage for a given investment.

Upon the selection of the proper size of locomotives will depend largely the operating labor expense. Every locomotive must have a motorman. In many states every train must have a trip-rider as well. Locomotives smaller than necessary mean more trains per given tonnage output, and, consequently, more wages per ton hauled. Trains should be made long enough to keep the number of locomotives required down to a minimum, but of such size as to keep those locomotives busy. Locomotives standing idle and motormen loafing run up the cost per ton of ore. Train length up to a certain limit means economy, but above that limit too long a train means expense, for very long trains are more subject to derailments than short ones, cause confusion at stations, and offer difficulties when loading from chutes.

Wider gages and heavier rails permit longer trains. There is an economical length—depending largely on the design of car and the capacity to be hauled. For the average small mine it is usually somewhere between twelve and twenty cars. The maximum weight of locomotive that can be used depends upon the gage and weight of rail used. Often it will pay to use a wider gage or a heavier rail than was at first selected, so as to use heavier locomotives, be able to haul longer trains, and reduce the number of locomotives required for a given output per shift.

Under maintenance expense, the upkeep of the haulage system as a whole should be considered. The upkeep of the overhead trolley wire on a trolley-operated system should be included in considering the maintenance of a trolley locomotive, just as the upkeep of the storage battery is almost invariably included in figuring the maintenance of a battery locomotive. In fact, for a fair comparison of real costs on a ton mileage basis there should be included locomotive maintenance, car maintenance, track maintenance, battery maintenance, if any; trolley maintenance, if any; motor-generator maintenance.

First cost should include consideration not only of the cost of locomotive and cars, but also of such factors as motor-generator or charging stations, trolley in place, and bonding of rails. The manner in which first costs enter into total operating costs is simply a question of business bookkeeping, and will not be discussed here.

As to safety, all haulage systems involve a certain accident hazard. The reduction of this hazard should receive major consideration. Apart from the humanitarian side of the problem, accidents are bad "business." They are costly and they tend to reduce operating morale. A safe system goes far toward reducing haulage costs. The possibility of danger from electric shock is usually the feature particularly in mind in considering the accident hazard of electric haulage systems; but there are others that should not be overlooked. They involve control and braking of the train, and protection for the motorman in case of collision. I believe as many train operators in min-

ing service are hurt by runaways and collisions as are injured by electric shock.

The value of flexibility in a haulage system is difficult to estimate. Yet it is quite real. Haulage systems can readily have a life of ten years or more. Few mines, especially lode mines, are operated on the same basis of development over ten-year periods. Physical conditions change, managements change, engineering ideas change, and metallurgical processes advance. A haulage system that may be ideal for present conditions may be a handicap ten years, or even two years, from now, unless that system has a certain flexibility which will permit its being adapted to changed conditions likely to be encountered. This aspect is worth thinking about.

Personal preferences enter into the problem of selecting haulage equipment on account of the personal element. Haulage equipment cannot be made strictly "foolproof," and operators usually get better results with equipment which they like than with that which they do not like. Features that render inspection easy—that facilitate adjustments and lubrication—tend to lessen maintenance expense. A machine that is easy to oil is almost sure to get more frequent and more adequate oiling than one which is so constructed that periodic oiling becomes a disagreeable and troublesome chore. Men will keep an easily adjustable machine in good adjustment, and will not so readily allow it to get in such bad adjustment that it has to be withdrawn from service for repair in the shop.

Power consumption enters into the cost of mine haulage to a less extent than is usually realized. It is seldom of sufficient importance to justify the selection of any one system of haulage. In half a dozen mines on which I have reasonably accurate haulage cost data power consumption constitutes only about 5 to 6 per cent of the total haulage operating cost. Ordinarily ten kilowatt-hours will haul about seventy-five tons of ore a mile on level track under average mine conditions. At the usual figure at which a mine buys power it can readily be seen that 10 per cent higher or lower power consumption does not make a great difference in the total cost per ton of ore hauled. Efficiency of the electrical equipment, on the other hand, is a matter of considerable importance, but not so much because of power consumption as because of the effect of efficiencies on securing a well-proportioned haulage system.

As a matter of actual fact, for average mining conditions the two systems, trolley vs. storage battery, will usually not show a great difference in over-all power consumption. I know that this is contrary to general impressions, but I have found it to be the case in scores of instances which I have analyzed.

A consideration of the foregoing factors will aid in the selection of the most economical haulage system for any specific condition. No general rule can be laid down as to when trolley haulage or when storage-battery haulage can be installed to best advantage. Each problem must be investigated separately. However, a few generally applicable remarks indicating the trend of recent engineering experience may be of service.

As a simple, rugged, reliable piece of haulage equipment, the trolley locomotive is the peer of all haulage motive power. As a means of moving trains quickly, irrespective of tonnage or distance, its superiority is unquestioned. The trolley locomotive can be built for any speed that a mine track will stand. It can be subjected to almost unbelievable abuse, both mechanically and electrically; it can be plugged, derailed, "slambanged" into trains of cars, and yet stand up to the service with a minimum of deterioration. It is handicapped by just one feature, and that is that it requires a trolley wire in order to be able to move about. Trolley wires may be a menace to safety and interfere with flexibility. In heavy or moving ground and about loading chutes they may be a decided nuisance and require a considerable attendance. Also, trolley wires and rail bonding cost money to install and to keep in condition.

The modern storage-battery mine locomotive is not the delicate piece of apparatus its detractors claim it to be —in fact, it is a mighty good mining machine; but it will not stand the abuse that a trolley locomotive can withstand. Operated with reasonable intelligence, and given decent maintenance, it will perform most satisfactorily in mine service; but it does need greater intelligence in its operation and more care than a trolley locomotive requires.

Actual mining conditions usually determine whether trolley or storage-battery haulage is the better to install. For large tonnages over long hauls the trolley system will almost universally prove most advantageous. For many frequent and diversified short hauls with moderate or small tonnages—gathering service, as it is termed—storage-battery haulage will probably prove more suitable. For small tonnages over moderately long hauls, storage-battery haulage will generally prove more economical, particularly as the investment and maintenance charge of the trolley wire and rail bonding for a trolley system must be divided among a comparatively few tons of ore hauled.

Long straight adits, in which high haulage speed is permissible and desirable, will always favor trolley haulage. Poor roof conditions, on the other hand, cause storage-battery locomotives to show up most favorably, because bad roof means trouble in keeping up the trolley wire, and a trolley wire down is not only a nuisance and expense, but means a haulage system tied up until the electricians are sent for and get in to clear up the trouble.

A mine system that involves constant advance of haulage drifts favors storage-battery haulage, because the storage-battery locomotive can follow development as soon as rails are laid, whereas the trolley locomotive has to wait for the stringing of trolley wire, with the attendant cleaning up of the roof and laborious realignment of the timbering.

Low roofs favor storage-battery locomotives as a matter of safety. Certain methods of stoping also are favorable to storage-battery locomotives in the haulage drifts, because many forms of chutes prohibit a trolley wire strung over the center of the track, and such chutes, unless all on the same side of the track, make trolley operation difficult.

Altogether, trolley haulage makes for speed and large output. Storage-battery haulage makes for convenience and flexibility. The variety of storage-battery locomotive types that have comparatively recently been placed on the market emphasizes the flexibility that can be attained with this form of haulage. Two or three manufacturers now sell a narrow-gage, single-motor, storage-battery locomotive that is particularly suitable for development work. This is a small, light machine weighing about 2½ tons and available for gages down to 18 in. It has a limited pulling power and a limited range of travel, but it will go almost anywhere and can displace three or four mules at a decided saving in cost of operation.

At least two manufacturers now make a midget locomotive—a small tandem affair built in halves, the leading half carrying the motor and the motorman, the trailing half carrying the battery. Each half is of such dimensions that it can be run onto the ordinary mine cage just like a mine car. It can thus be shifted from level to level in a mine with the greatest convenience. Coupled together, the two halves constitute a respectable haulage unit that will develop about 400 lb. drawbar pull at about 3½ miles per hour. The unit has short wheel base, so that it can take any reasonable curve. It is less than four feet high and so can go into low places and "snake" cars from anywhere that rails are laid. It marks about the ultimate in all-around flexibility.

A. I. M. E. Organizes Oregon and Philadelphia Sections

During the brief April trip of President Ludlow and Secretary Stoughton, of the A. I. M. E., they visited a number of the Institute's sections in the Northwest. On the evening of April 7, they also met twoscore members from Oregon, attending the convention at Portland, Ore., and assisted at the organization of the Oregon Section of the Institute under the chairmanship of Henry M. Parks.

On their return East the same two officials attended the meetings of American Engineering Council at Philadelphia, on April 16. Between meetings twenty-nine Philadelphia members presented a petition for the formation of a Philadelphia Section. A unanimous resolution then requested the directors to appoint an organizing committee with H. S. Drinker, chairman. This committee has summoned all members living within fifty miles of Philadelphia, to meet on May 16, 1921, at 1317 Spruce St., where a Philadelphia Section will be organized. May 16 is the semicentennial of the founding of the A. I. M. E. at Wilkes-Barre, Pa.

The Geological Society of Washington, D. C., held its 361st meeting on May 11, at the Cosmos Club. The colemanite deposits of California were described and their origin was discussed by W. F. Foshay. An illustrated talk on the glacial origin of the Fort Liscum landslide, given by B. L. Johnson, opened the session; and a longer, illustrated talk on "Relations of Vegetation to Geologic Formations," which was given by E. T. Wherry, brought the meeting to a close.

MEN YOU SHOULD KNOW ABOUT

Henry Krumb is in New York City on professional buiness.

C. A. Northcutt, of the South Chandler mine, Vermillion range, Minn., has gone to Denver, Col.

Herbert Hoover was made an honorary Doctor of Law by the University of Warsaw, Poland, on May 2.

Paul A. Gow, of Butte, Mont., general manager of the Tuolumne Copper Mining Co., was in Duluth, Minn., last week.

J. D. Reeside, Jr., is engaged in remapping a portion of the Ignacio, Col., quadrangle for the U. S. Geological Survey.

T. Wayland Vaughan has returned from Port au Prince, Haiti, where he has been inspecting geologic work for the U. S. Geological Survey.

Sverre Petersen, head of the technical department of Roxana Petroleum Corporation, St. Louis, Mo., was in New York City this week.

F. G. Clapp, petroleum engineer and consulting geologist, has moved his office to Room 2,025, Hudson Terminal Building, 30 Church St., New York City.

J. C. Metcalf, assistant chief engineer for Pickands, Mather & Co., Duluth, Minn., recently addressed the Ohio Section of the A. I. M. E., on Lake Superior iron mining.

W. A. Rose, chief engineer for Pickands, Mather & Co., at Duluth, Minn., has returned from Washington, D. C., where he went on affairs connected with mine income taxes.

Samuel H. Dolbear, mining engineer of San Francisco, Cal., was in New York City last week on his way to Ontario. His New York address was 1424 Aeolian Building.

Stuart St. Clair, consulting geologist, has removed his office from Chicago, Ill., to 55 Liberty St., New York City. He is now in the Oriental oil fields, where he will remain for a year.

Harvey Bassler, who has been working in South America for the Carter Oil Co. during the last year, was detained for a week at Corocoro, Peru, last January, as a Chilean spy.

Karl T. Sparks, mining engineer, attached to the Fairbanks, Alaska, experiment station of U. S. Bureau of Mines, was in New York City this week. Mr. Sparks recently spent a few days in Butte, Mont.

Prof. Waldemar Lindgren, head of the department of mining and geology, Massachusetts Institute of Technology, sailed for Bolivia on May 11. He will be absent on professional business there for about three months.

A. G. McGregor, engineer, of Warren, Ariz., sailed from New York City on May 11, for Peru. He will inspect the new smelter designed by him and now under construction there for the Cerro de Pasco Copper Corporation.

F. H. Fovargue, mining engineer, of Lake Helen, Fla., formerly general superintendent for the Chisos Mining Co., Terlingua, Texas, has accepted a position as general superintendent for the Monson Maine Slate Co. at Monson, Me.

Frank W. Pugsley, metallurgical engineer, of Pittsford, N. Y., for the last fifteen years with the McKinley-Darragh-Savage Mines, Ltd., will sever his connection with that company on June 1, owing to the closing down of the mines.

H. F. Ellard, mining engineer, secretary-manager of the Morning Club, Mullan, Idaho, has resigned that position to assume direction of club and social affairs in the Panama Canal zone. He has gone to Washington for his final instructions.

Prof. Robert Peele, of the Columbia University School of Mines, New York City, has been elected an honorary member of the Institution of Mining and Metallurgy, London, "in recognition of his eminent services in the advancement of mining science and education."

Dr. John B. Porter, head of the mining school of McGill University, Montreal, and a party of students recently spent a week looking over the mines of the Oliver Iron Mining Co. and the Cleveland-Cliffs Iron Co., in the Ishpeming, Mich., field of the Lake Superior district.

J. C. Dick, consulting mining engineer, announces that he has resumed professional practice, giving special attention to technical questions in the Federal tax law involving mines and other natural resources. His address is 1502 Walker Bank Building, Salt Lake City, Utah.

Frank T. Snell, mining engineer, has resigned his position as general foreman of steam-shovel operations for the Nevada Consolidated Copper Co., Ruth, Nev., to act as engineer with the western sales division of the Trojan Powder Co. His offices are in the H. W. Hellman Building, Los Angeles, Cal. His mailing address is R.R. No. 1, Box 334, San Gabriel, Cal.

Mining and metallurgical engineers visiting New York City during the last week included: **F. C. MacKrell**, West Point, N. Y.; **H. C. Anchor**, superintendent of Dome Extension Mines Co., S. Porcupine, Ont.; **E. O. Daue**, Easton, Pa.; **Albert E. White**, professor of chemical engineering, Ann Arbor, Mich.

SOCIETY MEETINGS ANNOUNCED

The Executive Board of Federated American Engineering Societies will hold its next meeting in St. Louis, Mo., on June 3, 1921.

American Society of Safety Engineers will hold its next meeting May 27, at 8 p.m., in Engineering Societies Building, New York City. The subject of the meeting will be "Electrical Hazards and Their Safeguards," and several papers by experienced men are on the program. All interested are invited to attend.

The American Iron and Steel Institute will hold its nineteenth general meeting at Hotel Commodore, New York City, on May 27. There will be a forenoon session (10 a.m. summer time), an afternoon session (2 p.m.), and a banquet at 7 p.m. Those desiring banquet reservations should address Howard H. Cook, assistant secretary, 61 Broadway, New York City.

American Society of Mechanical Engineers meets at Chicago, Ill., on May 23 to 26. Headquarters for this spring meeting will be the Congress Hotel. For reservations or information address C. E. Davies, assistant secretary, 29 West 39th St., New York City.

The Great Lakes regional meeting of the A. S. M. E., will be held at Cleveland, Ohio, on June 13 and 14.

American Society for Testing Materials will hold its annual meeting at Asbury Park, N. J., on June 20 to 24. The tentative program at hand indicates papers on cement, concrete, and refractories, for June 22 and 23; on petroleum products and testing, for June 23; on iron, steel and non-ferrous metals, for June 24. Headquarters will be the New Monterey Hotel. Further information may be had from C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

A Philadelphia Section of the A. I. M. E. will be organized at the Engineers' Club, 1317 Spruce St., Philadelphia, Pa., by members living within fifty miles of that city, on May 16. The meeting begins at 8 p.m. and all members of the Institute are invited. Dr. H. S. Drinker, a founder, will speak on the organization and history of the Institute since its foundation on May 16, 1871. After a discussion of the future usefulness of the organization, and the transaction of formal business, there will be a social smoker. F. Lynwood Garrison, temporary secretary, Drexel Building, Philadelphia, is making the arrangements.

OBITUARY

Albert Chapman Savage, civil and mining engineer, for the last ten years in Mexico, in the employ of the Esperanza Mining Co., El Oro, Mexico, died in that country on May 3, 1921, from injuries received when thrown from a horse last summer. Mr. Savage was born in New York City on Aug. 31, 1848, and was a graduate of Columbia University. He is said to have surveyed the first railway run through Texas. Later he specialized in aërial tramway construction.

THE MINING NEWS

LEADING EVENTS

Utah Copper Denied Rehearing Before State Supreme Court

Case Will Probably Be Carried Higher —Company May Build Own Power Plant

The application of the Utah Copper Company and seventeen other large users of power for a rehearing before the Supreme Court of Utah in the controversy with the Utah Power & Light Co. over increased rates charged by the power company and fixed by the Public Utilities Commission of the state has been denied. The way is left open for appeal to the U. S. Supreme Court, and it is probable that the case will be reviewed by it.

Utah Copper and the other companies seek to bring into question the right of the Public Utilities Commission to change the terms of contracts and raise the point as to whether any portion of the contract is binding when some of the terms have been altered by the commission. All of the protesting companies hold contracts with the power company, most of them entered into a number of years ago, and antedating the creation of the commission as a body. In this connection it is of interest that there is the possibility that Utah Copper will build a steam plant for it own power supply.

Date Set for Chicago Meeting Of Mining Congress

The twenty-fourth annual convention of the American Mining Congress will open in Chicago, Monday, Oct. 17. In conjunction with it will be the National Exposition of Mines and Mining Machinery. The Chicago Coliseum has been leased for this exposition.

Kruse and Tripp Settle Royalty Suit Out of Court

By mutual agreement the suit brought by Henry J. Kruse, of Crow Wing County, Minn., against Chester D. Tripp, of Chicago, was dismissed in the Federal Court. The suit was for a sum of $219,744.31, which was claimed for damages. The plaintiff alleges that he and the defendant entered into a partnership and acquired the mineral and surface rights of certain property in Crow Wing County, Minn., which was later leased to a lumber and mining company, and that the defendant received over $200,000 in royalties, but the plaintiff was not notified of the transaction, neither did he receive any portion of the money. The case was tried first in 1914, when the plaintiff was given a verdict, but owing to later complications the litigation has been going on for seven years.

WEEKLY RÉSUMÉ

Following the announcement of a 20 per cent wage cut by the U. S. Steel Corporation, affecting also the Oliver Iron Mining Co., orders have been issued to start shipping ore on all ranges from the latter's properties. The Federal Trade Commission has made a formal complaint against the corporation and subsidiaries because of the so-called "Pittsburgh-Plus" method of fixing steel prices. In the Birmingham district, the Gulf States Steel Co. has begun hoisting ore at the rate of 400 tons daily from the Shannon property, the first deep mining project in Alabama. In Montana, the Anaconda company has reopened the Nettie and Anselmo properties to mine silver-zinc ore, which will be smelted at the Washoe works, giving employment to 500 men. The Cascade Silver company's mill at Neihart has been burned down. In Utah, the Snake Creek tunnel case, involving the ownership of water developed in driving, is to be heard by the U. S. Supreme Court. The Utah Copper Co. and others have been denied a rehearing of the power contract case by the State Supreme Court. The Silver King Consolidated, of Park City, Utah, at its annual meeting, May 16, expects to consider the advisability of venturing in oil. In British Columbia, the reservation on the iron-ore deposits at Whitewater Valley in the Clinton mining division has been removed by the provincial government. The Silversmith Mines, at Sandon, has acquired the Ivanhoe concentrator. In Alaska, the Treadwell company is sending equipment to its new property on Nixon's Fork, in the Kuskokwim Valley. In Arizona the Verde Central, at Jerome, is reported to have cut an important body of copper ore.

At Washington, H. Foster Bain has been confirmed by the Senate as Director of the U. S. Bureau of Mines. The Senate passed the bill making the assessment work year coincide with the fiscal year, but rescinded its action to improve the wording of the bill.

Men Strike at Rochester, Nev.

Tonopah and Divide Situation Practically Unchanged—Nevada Packard Resumes at Lower Scale

The Tonopah and Divide strike situation is practically unchanged, although some companies are making an attempt to resume operations by importing outside men.

The employees of the Rochester Silver Corporation, at Rochester, struck against a cut of 50c. per day on May 4, affecting 120 men. The Nevada Packard, a few miles away, resumed operations a few days before this at a reduced scale after a 60-day shut-down.

Snake Creek Tunnel Case To Go To U. S. Supreme Court

Development Company Gets Writ of Certiorari—Right to Water Tapped in Driving Involved

The Supreme Court of the United States has undertaken to review the important case in which the Snake Creek Mining & Tunnel Co. and the Midway Irrigation Co., both of Summit County, Utah, are involved. The case turns on the ownership of water encountered in the Snake Creek tunnel driven for mining purposes. In this particular instance, the value of the water is estimated as being worth only $40,000, but the principle which will be established by the decision of the Supreme Court is of the greatest importance, since similar situations exist throughout the West. The tunnel company has been granted a writ of certiorari. At the time of the trial before the District Court of Utah, the tunnel had been driven into the mountain a distance of 14,500 ft. The considerable volume of water which was encountered is of value for power and irrigation purposes. The irrigation company which claims title to all of the waters of Snake Creek, a stream which drains a valley on which the tunnel opens, alleges that the tunnel has intercepted water which otherwise would have found its way naturally into Snake Creek. The irrigation company not only asks for an injunction against any use of the water by the mining company, but also asks that the mining company be enjoined from driving the tunnel further into the mountain.

The case was first tried in 1914 in the U. S. District Court at Salt Lake City, and the verdict was in favor of the Snake Creek company. Later this decision was reversed by the Circuit Court of Appeals, which found for the irrigation company, which claimed the water as a part of the surface waters of Snake Creek.

Mining men are awaiting the outcome of the suit with interest, as the question is one of vital importance to the industry, inasmuch as waters developed in the course of tunnel work may often be turned to profitable account in mining and milling operations, or revenue derived from the sale of such waters may be used to help defray the heavy expense of the work. On the Snake Creek tunnel, when work was stopped by litigation, there had been expended some $364,000. It can readily be seen that the possibility of losing any or all waters developed in tunnel work might easily act as a deterrent to the undertaking of work of this nature and thus operate to retard mining development materially.

American Zinc Institute Meets in St. Louis

E. H. Wolff, of Illinois Zinc Co., Elected President—Zinc Tarriff Not Discussed

BY P. R. COLDREN

E. H. Wolff, vice-president and general manager of the Illinois Zinc Co., was unanimously selected by the directors of the American Zinc Institute to head the organization for another year, at the close of a highly successful two-day session at St. Louis on May 10. A. P. Cobb, Cornelius F. Kelley, and F. C. Wallower were elected vice-presidents, Howard I. Young was chosen as treasurer, and S. S. Tuthill, of New York, was re-elected for his fourth term as secretary.

Directors selected for the term ending 1924 include: Charles W. Baker, J. H. Billingsley, P. B. Butler, Julius W. Hegeler, Cornelius F. Kelley, William A. Ogg, and H. S. Wardner. A vacancy in the 1923 group was filled by the selection of Benjamin Lissberger.

Although the attendance at the meeting was not greater than in other years, the general opinion was that it was one of the best meetings yet held. Approximately ninety members of the institute registered, about one-third of them being from the Tri-state zinc and lead district and the others from all over the country, representing zinc mining, zinc smelting, and manufacturers of zinc products.

There was no discussion as to the tariff at the meeting, this subject being dismissed with a brief statement from President Wolff, who told what had been done and expressed the opinion that tariff protection for zinc is assured in the new tariff bill.

A resolution asking the U. S. Treasury Department to use alloyed zinc for making the new 2½-cent piece which is under consideration was presented by H. T. Hornsby and passed unanimously. It bases the request on "grounds of economy, efficiency, and the encouragement it will extend to a key industry."

Charles T. Orr, past president of the institute, was toastmaster at the annual dinner held on Monday evening, at which Dr. W. F. Gephart, dean of commerce and finance at Washington University, was the principal speaker. He sounded a note of encouragement as to the financial outlook and expressed the opinion that the world may fairly expect to go into the year 1922 near normal and with a period of unprecedented prosperity immediately ahead. Other speakers at the dinner included A. P. Cobb, vice-president of the New Jersey Zinc Co.; C. E. Siebenthal, Dorsey A. Lyon, and President Wolff.

Among the papers of note read at the meeting was one by Frederick Laist, in charge of the electrolytic zinc plant of the Anaconda Copper Mining Co. Mr. Laist said that the electrolytic process has made remarkable progress in the six years in which experimental work at the existing plants has been carried on. "From a war baby," he said, "it has grown into an industrial process which has demonstrated its ability to produce zinc in competition with older processes and unquestionably has come to stay." However, he declared that it lacked much of mechanical perfection and that great improvements can be and will be made.

The present output of electrolytic zinc was given by Mr. Laist as 125,000 tons per annum. He stated the record production at the Great Falls plant was made last July, when a total of 11,801,662 lb. was drawn. He predicted that the future will see electrolytic zinc plants operating on high-grade ores and actually producing their power by the combustion of coal, oil or gas. He said that the amount of labor required for producing a ton of electrolytic zinc is not more than one-third of that required to produce the same amount by the furnace method, and that the total investment will be little if any greater than for the distillation method.

In his paper on "Increasing the Consumption of Zinc," W. H. Hendricks, of the New Jersey Zinc Co., suggested that this may be accomplished by re-establishing old markets at the earliest possible date; by increasing the consumption of zinc in the present consuming industries; by discovering new uses for present products; by development of new products for present needs; and by developing new products and creating new needs.

One interesting suggestion made by Mr. Hendricks was the substitution of a mixture of zinc chloride and zinc oxide for plaster of paris for patching cracked plaster walls. He also suggested that mention should be given to the matter of improving the use of zinc chloride for wood preservation.

J. J. Rutledge, in charge of the Mississippi Valley Experiment Station of U. S. Bureau of Mines, told of some of the things that are being planned for the purpose of aiding the mining industry, and asked for further suggestions. His request was supplemented by an appeal from Dr. Lyon. A lively round-table discussion, led by Arthur Thacher, of St. Louis, followed.

During this discussion the matter of getting accurate figures of production and consumption for the industry was gone into, and the point was made by the mining men that the smelters should be willing to give up such valuable information if the ore producers were expected to do so. The smelter men present intimated they would be willing to co-operate fully.

Other subjects that came before the meeting were as follows: "Zinc Roofing and Building Products," by C. H. Stewart, of the American Zinc Products Co.; "Uniform System of Cost Accounting for Mines," by George W. Potter, of the Eagle-Picher Lead Co.; "Value of Trade Papers in Relation to the Zinc Industry," by G. F. Creveling; and reports on the zinc producing fields by Otto Ruhl, Charles Bocking, A. M. Plumb, Howard I. Young. A résumé of the general zinc situation was made by the secretary, S. S. Tuthill.

The board of directors, after adjournment, passed a resolution asking the Commissioner of Indian Affairs to act immediately on the matter of Indian leases in the Tri-state field and "to promulgate a set of rules liberal enough to enable the zinc industry of Oklahoma to adjust its business and to conserve the orebodies of that district for future profitable use."

There were no exhibits of zinc products at the meeting other than zinc shingles or tile, made by the Illinois Zinc Co. and the American Zinc Products Co. It was voted to hold the next meeting at St. Louis.

Reserve Removed on Iron Ore in Whitewater Valley, B. C.

Provincial Government Takes Action Following Adverse Report on Deposit by Vancouver Engineer

A considerable section of the Clinton mining division of British Columbia, known to contain iron-ore deposits of importance, was placed under reserve by the Provincial government about a year ago, it being thought that investigation might prove that these deposits could be made to play a vital part in the development of an iron and steel industry. This reservation was removed recently on the recommendation of the Minister of Mines, the report of the government mining engineer, made in 1919, after a brief and superficial examination, having failed to receive the substantiation of F. J. Crossland, a mining engineer of Vancouver, B. C., who went into the district last summer. He was properly outfitted, made an early start, and so was able to prospect all the limonite ore occurrences and to furnish what may be accepted as a good approximation of the tonnage available.

Mr. Crossland's report deals with an area of fifteen square miles of the upper part of Taseko Valley. He finds the ore is a secondary limonite and that it occurs as surface deposits following the present contour of the ground. The deposits are patchy and vary from 1 ft. to 5 ft. in thickness. Eight widely separate deposits are described. The McClure Mountain deposit is referred to as one of the chief among those of appreciable size. It contains nearly half a million tons of "positive ore." Whale Mountain contains half a million tons of "probable ore." The total of "positive ore" in eight deposits is placed at 672,741 tons and "probable ore" at 911,250 tons. The ore is homogeneous and of good grade, averaging 50 per cent iron, with no impurities that would affect its value as a supply for blast furnaces. The deposits consist of a number of widely separated aggregates.

It would appear from the report that the tonnage of ore in the area placed under reserve is not sufficient to warrant installing the equipment necessary for working the deposits. The scattered nature of the deposits and the difficulties of transportation make exploitation impracticable.

To Aid Prospectors in Obtaining Powder

The "bona fide mineral prospector" is to be assisted by the government of British Columbia to obtain cheap powder for the development of mineral properties. The last session of the Legislature appropriated $10,000 for this purpose, and William Sloan, the Minister of Mines, has approved of rules to govern the distribution of this fund. Twenty-five per cent of the legitimate cost of the powder at the point of purchase is to be granted in the form of a rebate. Applicants must prove to the satisfaction of a mining recorder or a mining engineer employed by the government that they are "bona fide mineral prospectors."

Rebates will be allowed on a basis of not more than ten cases of powder to each applicant in one year, except where "exceptional circumstances" are proven and on the "written recommendation of a resident engineer of the Department of Mines." Applicants are required to sign declarations, upon forms supplied by the Department of Mines, setting out the legal definition of the ground on which powder has been used and the number of cases of explosives actually used in prospecting such ground, and an invoice of the powder purchased must be furnished. To make the conditions clear: if powder is bought in centers where it is comparatively cheap, the rebate or subsidy will be based on such cost; if it be bought at outlying points at a higher price, the percentage will be figured on the higher cost. This is considered to be better than a straight rebate.

Steel Corporation Must Answer As to "Pittsburgh-Plus" Plan

The Federal Trade Commission has at last issued a formal complaint against the United States Steel Corporation and eleven subsidiary companies relative to the plan of making prices known as "Pittsburgh Plus." This action was due to the petitioning by 2,700 fabricators of steel in the Chicago, Birmingham, and Duluth districts. About two years ago the Federal Trade Commission was requested to assume jurisdiction on this matter, but failed to do so after a careful survey. Since then the personnel of the commission has changed, and the present commission voted 3 to 2 to issue the complaint, which allows until May 31 for an answer, after which the case will be brought to trial on its merits.

American Delegates at Portland for Tariff Increase on Lead and Zinc

In the account of the recent mining convention at Portland, Ore., that was published in the *Engineering and Mining Journal* of April 23, it was stated that strong opposition developed to the convention putting itself on record regarding an increased tariff on lead and zinc and that the matter was dropped. Thus far the report was correct, though incomplete. The convention, being international in character and including Canadian delegates, did not take action regarding a tariff, but at a separate meeting the United States delegates passed the following two resolutions bearing on the matter:

1. Whereas the lead and zinc industries of the United States have been seriously affected by the lack of adequate tariff upon foreign ore and bullion, thus leading to a condition leading to the suspension of the entire production of Missouri and two-thirds of the production of all the western states; and,

Whereas, without a substantial protective tariff the lead and zinc industries of the United States cannot survive: Now, therefore, be it

Resolved by a special convention of the United States delegates held during the Third International Mining Convention assembled at Portland, Ore., April 5-9, 1921, that the Congress of the United States be, and hereby is, respectively urged to adopt such changes in the duties upon lead in ores and its products as will provide for a tariff equal to 2c. per lb., and that an increase in the tariff on spelter and zinc ores be provided in conformity with the recommendations of the American Zinc Institute.

2. Whereas the Idaho Mining Association, through intelligent work at Washington, has done much to impress upon Congress the necessity for increase in the present protective tariffs upon lead and zinc; and

Whereas, such increased tariffs are essential to the preservation of the industries and therefore to the prosperity of all the West: Now, therefore, be it

Resolved that delegates to a special convention of the United States delegates held during the Third International Mining Convention, assembled at Portland, Ore., April 5-9, 1921, extend thanks to the Idaho Mining Association and particularly commend the work of Jerome J. Day, president, and Ravenel MacBeth, secretary of that organization.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Assessment Work Year Made Same as Fiscal Period

But Senate Promptly Rescinds Action To Perfect Wording of Bill—Measure Likely To Pass

After passing a bill to change the assessment work year to a fiscal year basis, the Senate rescinded its action to permit of perfecting the language of the bill. As the bill passed by unanimous consent, it is very evident that the measure can be passed at any time that it is brought forward again. There always has been widespread objection to the calendar year basis for assessment work. The general tendency is to wait as late in the year as is possible before performing the assessment work on mining claims. Since weather conditions are adverse in most of the mining regions of the country during the latter part of the calendar year, it is generally agreed that a fiscal year basis is better.

The bill, which was passed and subsequently recommitted to the Committee on Mines and Mining, contained the expressed proviso that it was not to interfere in any way with the extension to July 1, 1921, of the privilege of doing the 1920 assessment work. Nor was it to be construed that the performance of the 1920 work was to be excused. Senator Poindexter, the chairman of the Committee on Mines and Mining, has expressed himself as being unalterably opposed to any further suspension of assessment work. Several bills have been introduced providing for the suspension of the 1920 assessment work, but it is generally believed that such bills will not pass and that the 1920 assessment work will have to be performed prior to July 1.

Brass and bronze rods to the extent of 953,000 lb. have been offered for sale by the Ordnance Salvage Board. Sealed bids are to be received until 11 a.m. May 31.

War Mineral Claimants Hopeful of Further Allowances

Favorable Report on Shortridge Liberalizing Bill Brightens Outlook—If Passed, Will Reopen All Claims

The favorable report made to the Senate by the Committee on Mines and Mining on Senator Shortridge's bill liberalizing the War Minerals Relief Act and the possibility that the new Secretary of the Interior may approve this legislation have given rise to hope among claimants that there will be a material increase in the amounts allowed on war minerals claims.

Since an identical bill passed the Senate at the last session, it would not be surprising were the Shortridge bill to go through the upper house without objections. The difficulties with which the legislation will meet will be in the lower house. The principal argument which probably will be used against

the bill is the contention that an additional appropriation of from $8,000,000 to $10,000,000 will be required.

The Shortridge bill is an effort to remove what is generally regarded as an inequity. Under the act, as it stands, claims can be considered only when there was a personal request or demand from the Government. This is amplified in the Shortridge bill, so as to include those who were induced to undertake the development of war minerals by published statements emanating from Government officials. This liberalization, it is stated at the office of the War Minerals Relief Commission, means that every claim will be reopened. This includes the claims on which awards already have been made, since it means that an earlier date of stimulation may be shown.

The aggregate of the amount claimed, under the act, is $18,000,000. Of that amount, the War Minerals Relief Commission has discarded some $12,000,000 worth of claims. If the law is allowed to stand as it is, some $4,500,000 of the original appropriation will be turned back to the Treasury. It is calculated that liberalization, as provided in the Shortridge bill, will call for $2,000,000 worth of additional awards on the claims on which payments already have been made, in that it will extend the period of stimulation. In addition, some $10,250,000 would be required to make payments on claims which had been disallowed under the existing act. Thus, additional payments of $12,250,000 probably would be made possible if the Shortridge bill should become a law. It would not be necessary to appropriate all that amount, as $4,500,000 of the existing appropriation remains available. To the amount of the claims must be added the administrative expense of the commission.

Bain Confirmed as Director of Bureau of Mines

Has Returned From Extended Tour of Mining Camps—Finds Conditions in Copper Country Significant—Zinc Smelters Seeking To Better Practice

Dr. H. Foster Bain was confirmed by the Senate as Director of the U. S. Bureau of Mines on May 10. After nearly a month spent in several important mining regions, Dr. Bain he returned deeply impressed with the business depression. He regards it as significant that the Calumet & Hecla mines have been forced to shut down. The company was particularly proud of its record of having maintained continuous production for more than half a century, despite depressions or other adverse economic factors.

The suspension of mining in the copper region is having the incidental effect of causing the immigration of English miners. Much of the early success in this region is attributed to the ability of the district to draw a material portion of its help from the professional miners of Cornwall and other parts of England. A number of years ago the type of immigration changed and it became necessary to recruit miners largely from among Finns and Sicilians. Though many good miners have been developed from these nationalities, the general tendency of these peoples is toward agriculture. As a result, there is a very large turnover among the working forces in the mines. More than that, they are not miners by profession and consequently must be trained. Since the war there has been a considerable influx of Cornish miners. The closing of the mines is making it impossible to encourage an increase in this type of immigration.

Though business prospects in Missouri's zinc mining region are more gloomy than ever before, Dr. Bain sees one hopeful tendency. The zinc smelting industry has come to realize some of the weaknesses of its present smelting practice and is taking advantage of the depression to do research work. One of the matters being taken up is the combustion problem in the plants using natural gas. In that and other problems Dr. Bain expects the Bureau of Mines to be able to extend material assistance.

Another phase of the zinc smelting problem in which the bureau is now receiving the active co-operation of the interests concerned is the matter of preventing waste and extending the life of the natural gas fields.

After a careful personal survey of the situation, at the southern experiment station of the bureau, which is operated in connection with the University of Alabama, the conclusion has been reached that one of the main studies at that station is to be on byproduct coke, especially with reference to its use in blast furnaces. There is great difference of opinion as to just what physical characteristics have a bearing on the quality of coke. The claim is made frequently that much of the byproduct coke is inferior. When coal is treated for the sole purpose of making coke, every attention is given that one product, with the result, it is claimed that a superior and more uniform coke is made. In the byproduct ovens, chief attention is given to products other than coke, which results in an inferior coke, some declare. This has accentuated the need for more definite knowledge as to the physical characteristics which add to or detract from the quality of coke that is manufactured.

NEWS BY MINING DISTRICTS

Special London Letter

Values Falling at Depth in Lonely Reef and Vein Flattening — Easing the Nigerian Tin Situation—Southern Van Ryn Reef in Need of Funds

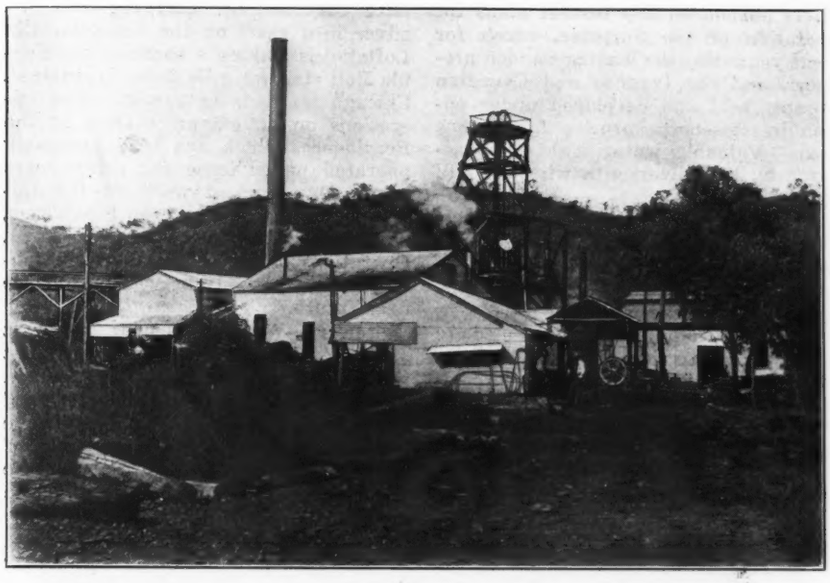
BY W. A. DOMAN

London, April 29—Next to the Globe & Phoenix the Lonely Reef is the premier gold mine of Rhodesia. The gold content of the ore is high, as will be gathered from the fact that the ore reserves at March 31 last, amounting to 200,555 tons, have a value of 19.98 dwt. This compares with 199,739 tons at Dec. 31, 1919, averaging 23.54 dwt. The fall in the value is pretty substantial. A high yield is required, seeing that expenses are high, and are greatly increased by the royalty paid to the British South Africa Co. For instance, last year 59,270 tons was milled, yielding 64,408 oz. of gold. The working costs were £156,636 or 52/6 per ton crushed, and the royalty raised them to 60/1 per ton. The cost per ounce was £2/76. In 1919 the expenses both in London and Rhodesia were 45/5 per ton, and the royalty 9/2, making the total 54/7. The per ounce figure was £2/10. As showing how working profits are eaten into it may be mentioned that from the surplus last year of £198,983, royalty claimed £22,442, and British and Rhodesian income tax £42,039, together 32.4 per cent. Of the balance of £134,500 shareholders received in dividends £111,790, or 50 per cent less income tax.

The ore in the lower levels of the mine maintains a good width—from 31 in. to 50 in., but values are falling off. Between the 20th and 21st levels reserves have a value of 26.49 dwt.; between the 21st and 22d the value is 19.96 dwt., and between the 22d and 23d 13.58 dwt. Only a small tonnage is so far opened up below this horizon, and the assay is 7.97 dwt. A point worth mentioning is that from the 15th level downwards the reef shows a gradual reduction in dip. This is a rather serious matter, as it involves longer crosscuts at each level. At the 24th level the crosscut is 229 ft. long. This entails much expense and a new incline shaft close to the reef is to be sunk from the 24th level.

Further attempts are being made to revive interest in tin mining in Northern Nigeria. Government regulations are being relaxed and hopes are entertained of a substantial reduction in railway rates.

The Burma Corporation deal with the Associated Lead Manufacturers is not to go unchallenged. It is alleged that the notice convening the meeting at



SURFACE PLANT OF STATE-OWNED EINASLEIGH COPPER MINE, QUEENSLAND, AUSTRALIA

which the arrangement was made failed to disclose one or two important matters. As a result, Lord Harris, as representing the Consolidated Gold Fields; Sir Henry Strakosch, for the Union Corporation, and several representatives of the Stock Exchange are conferring with certain members of the Burma Corporation board on the matter.

An example of the difficulty experienced by some mining companies in obtaining capital is that of the Southern Van Ryn Reef, which owns a property in the Far Southeast Rand. The directors are offering 2,000 six-year 10 per cent notes of £50 each, a premium of £50 to be paid on redemption. Funds are required to complete a plant capable of treating 7,500 tons a month. Repayment requires £200,000, and the interest during the period would be £60,000. At the rate of 7,500 tons monthly six years would consume 540,000 tons. To cover the note service only each ton would have to yield a profit of approximately 10/—. Seeing that the property is only just being opened up, and the bulk of the plant has to be obtained, the prospect of the notes getting their 100 per cent premium is far from bright. The Consolidated Gold Fields had the management of the mine at one time and gave it up.

The Cam & Motor treatment plant does not yet appear to be working satisfactorily. For March 10,052 tons were crushed by ball mills, the screen value being 43/9 per ton, or a total of £21,988. The total concentrates won were 1,142 tons, value £9 13s. per ton, or, say, £11,020. There is consequently much to be done to improve the extraction.

KOREA

Unsan — The April cleanup of the Oriental Cons. was $97,000, against $108,500 in March. The Tabowie mine fire is still burning, though the volume of gas and smoke is decreasing.

Australia

Queensland

Chillagoe State Smelters Down—Development at State-Owned Einasleigh Copper Mine Continued—Cobalt Mine Near Selwyn To Install Concentrator

Brisbane, March 26—The continued fall in the price of metals is having a disastrous eeffect on mining in Queensland, in common with the other Australian states. The three large copper-producing and smelting companies in the Cloncurry district are still idle, and work on copper properties in that field has ceased except for a small amount of development at some of the best mines. A few miners are, because there is nothing else for them to do, still "gouging" and storing their product. Tin mining is also affected, though in lesser degree. Mining for wolframite and molybdenite has ceased altogether. Fortunately, Mount Morgan is, with the assistance of its gold production, still going, but the company has just announced that it must curtail operations. It is now the only company mining and treating copper in Queensland, or, with one exception, in Australia.

Apart from Mount Morgan, the only smelting concern that resumed operations after the Christmas holidays in Queensland was the Chillagoe State smelters, and now these have shut down. The Minister for Mines was, up to two or three weeks ago, hopeful that he would be able to keep these works going, and thus avoid increasing unemployment in the district, but miners would not send in their ores at the ruling prices, and the smelters simply had nothing to work upon, and there was no alternative but to close down until the markets improve.

The government, however, has decided, to keep some men employed, to go on with development at the Einasleigh, a copper mine with an extensive body of low-grade ore situated in the Etheridge field on the Copperfield River, with picturesque surroundings and interesting geological features. This was the principal mine brought by the government with the Chillagoe works and railways and last year it furnished three-quarters of the ore supply for those works. During the first half of 1920 the average production was 450 tons of ore weekly, but this was increased to upward of 500 tons per week toward the close of the year. The mine still holds extensive ore reserves, and is capable of a further substantial output for a long period. Based upon the quantity and assay value of the ore developed, it was estimated that about 2,500 tons of copper would be derived from the mine during the first eighteen months the smelters were in operation. The Einasleigh, however, was the only mine in the district bought by the state that the government had power to work, and this restriction was found to impede the operation of the smelters,

EINASLEIGH TOWNSHIP AND MINE, QUEENSLAND, AUSTRALIA

which never had an adequate supply of ore to keep them fully employed; consequently a special act of Parliament was passed last session giving the Mines Department power to work other mines which the government has acquired, but of course there is no inducement for a start to be made in this direction under conditions existing at present.

The cobalt mine near Selwyn in the Cloncurry district, continues to develop well, and indeed promises to assume dimensions that will give it a world-wide prominence. Since the shipment of the 50-ton parcel of ore to England about two months ago, as a trial lot, another 30 tons has been dispatched from the mine. The main shaft has reached a depth of 112 ft., and over 50 ft. of driving has been carried out on the lode at the bottom. Another shaft—the south shaft—is being sunk, and when this bottoms it will be connected with the main workings. In addition, development work is being conducted in two other shafts, and altogether twenty-one men are kept employed. As evidence that the owners of the mine have every confidence in its future, they have completed arrangements for the installation of a concentrating plant, to cost £40,000. At present a hand jig is operating on the dump.

It looks as if the newly formed company working the Mount Quamby gold mine, also in the Cloncurry field, have a good thing. The return from fifty-four tons of ore from this conglomerate deposit, sent to Charters Towers for treatment, is 28 oz. of smelted gold worth £3 13s. 4d. per oz.; ten tons of concentrates assaying 1 oz. 8 dwt. per ton, and forty tons of sands assaying 4½ oz. per ton. If this is a fair sample—and the manager of the mine says it is—the yield is quite "good enough," although not up to the predictions of some over-sanguine persons who have been busy booming the proposition. It is intended to install a battery at the mine.

CANADA

British Columbia

Silversmith Mines Acquires Ivanhoe Concentrator—Slocan Miners Vote To Accept 75-Cent Cut

Sandon—The Silversmith Mines, Ltd., has acquired the Ivanhoe concentrator from the Minnesota Silver Co., and the W. H. Yawkey estate, and will spend about $40,000 remodeling and enlarging the plant, which is to be connected with the Silversmith by an aërial tram. This acquisition will about double Silversmith's daily milling capacity and will make winter milling operations possible. The present Ivanhoe mill was constructed by the Rosebery-Surprise Mining Co. in 1916 to replace the old Ivanhoe mill destroyed by fire in 1914. It has been idle over two years. Its acquisition by the Silversmith interests is taken to mean that the Rosebery-Surprise management has definitely abandoned any further plans for operation of the Surprise, which for some years was the leading Sandon producer, and the Ivanhoe and Canadian groups, held and developed under option by Rosebery-Surprise for over a year. Valuable water rights are secured by the Silversmith with the mill and millsite.

In recent years work on the Noble Five mine has been confined to development of the vein system at depth, connecting the lower with the upper workings by means of a 1,000-ft. raise and establishing intermediate levels. The erection of a 100-ton concentrator was started in 1919 and completed during the summer of 1920. Other improvements include the erection of a modern bunk house and buildings. Owing to lack of labor the mill was started up on ore from one of the old dumps and the first carload of silver-lead concentrates was shipped to the Consolidated Mining & Smelting Co.'s smelter at Trail late last year.

NOBLE FIVE MILL AT SANDON, B. C.

Miners of the Slocan, in British Columbia, have voted to accept a wage reduction of 75c. per day for all classes of mine and mill labor. The new scale went into effect May 6 and ranges from $5.50 for skilled labor to $4 for roll men, jig men, muckers and common labor.

Cranbrook—The Gamble Placer Mining Co. has arrangements made for an active season's operations on Wild Horse Creek. About $20,000 has been invested in the project, a large portion of which was expended on flume construction last season.

Golden—Through efforts of the East Kootenay Prospectors' Association, capital has been interested in the Vermilion River talc property, near Castle station, on the main line of Canadian Pacific Railway. The material is said to lie in a 30-ft. vein and to be near transportation.

Greenwood—The outlook is favorable for a fairly active season in this vicinity. Morrison and Gills are driving a crosscut to tap the main vein on the Tam O'Shanter. Bombini & Co. have cut good ore carrying lead and silver in a shaft on the Vendella. Ola Loftstad is sinking a shaft on the Bonnie Bell claim, a mile from Greenwood. Chicago interests have commenced operations on an extensive scale at the Providence, which has been profitably operated under lease for some years past. Development work on the Defiance, which is close to the Providence, was started the latter part of April. Operations on the Jewel, a gold proposition, may possibly be resumed in the near future.

Stewart—Work of clearing the right of way for the aërial tramway that will connect the Premier mine, Salmon River, with tidewater is making good headway. Separate contracts have been let for practically every mile of the eleven and one-half miles, with the idea of speeding its completion. The points where the stations will be located have not been determined.

Alice Arm—The situation in this mining community is not bright. The plans of the Dolly Varden Mines, Ltd., for this summer are not known. With silver so low and mining costs comparatively but little reduced it seems doubtful whether the mine could be operated profitably.

Vancouver—D. G. Marshall, a director of the Britannia Mining & Smelting Co., is authority for the statement that plans are being drawn for a new concentrator, to replace the one destroyed by fire on March 19. He stated that, owing to the strong financial position of the company, it would be possible to go ahead with the construction work without waiting for settlement by the insurance companies. The new plant will not differ greatly, either in capacity or design, from the one that was destroyed, as the old plant gave excellent metallurgical results. It is hoped that the plant may be running early next year.

Trail—Ore shipments to the Consolidated smelter during the week ended April 30 consisted of 12,023 tons from the company's mines and 33 tons from the Sally, at Beaverdell.

Ontario

Hollinger Seeks Permission to Develop Power at Kettle Falls

Porcupine—The Hollinger Consolidated has applied to the Ontario government for the right to develop hydroelectric power at Kettle Falls, twenty-five miles north of Cochrane, on the Abitibi River. It is estimated that approximately 35,000 hp. may be developed there.

Kirkland Lake—The new mill of the Wright-Hargreaves is running smoothly, treating 125 tons of ore daily.

The offices of the Kirkland Lake Proprietary (1919) have been removed from Cobalt to Kirkland Lake.

Excavation work for the new mill is in progress at the Ontario-Kirkland.

Larder Lake—The new three-compartment shaft on the Kerr-Addison property of Canadian Associated Goldfield has reached a depth of 260 ft.

Boston Creek—To finance diamond drilling and underground exploration, the directors of the Miller Independence have decided to issue $50,000 in bonds maturing in three years and carrying 8 per cent interest. The company has reserved 150,000 treasury shares and gives the purchasers of bonds the right to exchange them for this stock at any time before maturity on the basis of three shares for each dollar in bonds.

Beaver House Lake—The Argonaut company purposes to erect a new modern mill as soon as justified by developments, which should greatly increase the percentage of recovery. One ore shoot is stated to have a length of 200 ft. and a width of 6 ft., carrying an average gold content of $15.75 to the ton.

Gowganda—There has latterly been a considerable revival of activity in this district, which has been badly handicapped by transportation difficulties and during the winter by power shortage. The Miller Lake-O'Brien which was compelled greatly to curtail operations, has now a full supply of power and is working to capacity with three shifts. Several properties have been reopened, including the Gowganda, Enterprise, McAlpine, Powerful and Saunderson, the last named of which is getting in a small steam plant.

Quebec

Kazubazua—Gold is reported to have been found near the town of Kazubazua, in the Galienean district, about forty-five miles north of Ottawa.

Newfoundland

A new agreement has been signed between government of Newfoundland and the Dominion Iron & Steel Co. and the Nova Scotia Steel & Coal Co. covering an export tax of 25c. a ton for twenty years from Jan. 1, 1921, on all ore shipped to Nova Scotia and free exportation to all countries other than Dominion of Canada. The companies must spend $3,000,000 in the next five years in improvements and development of their plants. They are exempt from business profits tax.

CALIFORNIA

Engels Copper To Start Adit To Develop Upper Mine

Engelmine—The Engels Copper Mining Co. at Engelmine, Cal., will begin driving an 8,000-ft. adit to develop its upper mine, known as the Engels mine, at greater depth. Preliminary diamond-drill exploration has indicated the downward extension of the orebodies and the adit will enable the development of these orebodies to be carried out. When the adit is completed it will also simplify the handling of ore from the upper mine.

Keswick—The Mountain Copper Co., Ltd., will construct a wire-rope tramway from its Hornet mine in Shasta County to a point one mile south of Motion, a station on the Southern Pacific railroad. The distance is approximately 2½ miles and the vertical altitude drop 1,400 ft.

Winthrop—The Shasta Zinc & Copper Co. is proceeding with the construction of its zinc oxide and copper smelting plant at Winthrop. It will be ready for operation in a few months.

Amador City—Discovery of a narrow, high-grade orebody on the 2,600 level of the Bunker Hill mine has been announced. The Fremont Consolidated is completing the rehabilitation of underground workings.

The new wage scales of most of the Mother Lode mines approximate $4 per day for miners and machine men; $4 to $4 25 for millmen; and $3 to $3.50 for surface men. The reduction became effective May 1.

Volcano—Hydraulicking on the Mary Ives Crocker estate by O. A. Stewart is reported to have given a satisfactory cleanup, and operations on a more extensive scale will be undertaken in the near future. Ludeken Brothers are hydraulicking near Volcano.

NEVADA

Tonopah Mining Co. Examining Orleans Mine at Hornsilver

Mina—In a recent statement to stockholders the Simon Silver-Lead Mines Co. states that the mill building is completed and machinery is now being installed. The plant will be entirely completed by the time electric power is available. Active work was resumed in the mine May 1. Further development will be done on the lower levels.

Tonopah — Strike conditions in both the Tonopah and Divide districts remain unchanged, most of the companies not operating. West End tonnage for the week was 1,600. It is reported that the general offices of the Tonopah Belmont company are to be removed to Tonopah from San Francisco, the change to be made about May 15. The offices were moved to San Francisco in 1916, at which time work was being started on the Surf Inlet mine in British Columbia, the Shawmut in California, and the Belmont Wagner in Colorado. The Surf Inlet mine is now in full operation and the two latter are closed down awaiting better operating conditions.

Goldfield—The shaft of the Goldfield Deep Mines Co. has reached a depth of about 500 ft. and the larger hoist is to be installed before the end of May. No special developments are expected before a depth of 1,000 ft. is attained, when the C.O.D., Gold Bar, and Victor veins should be cut. These veins were productive of high-grade ore near the surface. Lessees in the Florence are said to be doing very well. High-grade ore has been opened up at several points, and although the width of ore is narrow there is always the possibility of widening and making into one of those bonanza orebodies for which the Goldfield district has always been famous.

Hornsilver — Engineers of the Tonopah Mining Co. are making an examination of the Orleans mine. The present lessee, J. W. Dunfee, who recently opened a promising orebody on the 600 level, has temporarily stopped work.

Virginia City—The United Comstock is making good progress in its main haulage tunnel and on other preparatory work. The tunnel has been driven about 3,400 ft. and is over one-third completed. Branch tunnels, to connect the various shafts with the main haulage, will soon be started from the Knickerbocker, Jacket, Imperial and Jacket Belcher.

Spanish Belt—The Cons. Spanish Belt Silver Mining Co., operating the old Barcelona mine, fifty miles north of Tonopah, is rapidly getting ready for production. It is engaged in completing the erection of a mill under direction of Lou Townsend. This plant consists of ten 1,050-lb. Union Iron Works' stamps, four tables, and an oil flotation unit of a capacity of about fifty tons in twenty-four hours. The heads are expected to run around $30 per ton and the ratio of concentration to be about 20 or 30 to 1. Tests show that about 60 per cent of the values can be saved by wet concentration and the remainder by flotation.

The mill is expected to be completed about June 1, when the mine will be electrified. The company has recently obtained a permit from the Federal Power Commission allowing it to connect with the Nevada-California Power Co. The five-mile high-tension power line is now completed and telephone connection has been made with Manhattan and Tonopah.

The company operates a fleet of four-wheeled drive trucks which will handle the concentrates and supplies between Tonopah and Spanish Belt. E. J. Schrader is superintendent.

Pioche—The development shaft being sunk by the Prince Consolidated entered ore at 662 ft., passing out of it at 690 ft. This bed was known to exist, and the assays checked closely the results obtained from the diamond drill cores, averaging 1.2 oz. silver and 0.7 per cent lead.

A lease has been given to John Mitchell, J. H. English, and associates on the Bristol slag dumps, at Bristol Wells, about four miles south of Silverhorn. The dumps are being sampled,

and selected material will be shipped as fast as the dump can be trenched. A favorable treatment rate has been obtained from the smelter.

John F. Roeder has granted a lease on the Gypsy mine, at Stampede Gap, in the Highland mining district, to J. F. Hall, John Smith, and C. Smith.

A substantial reduction has been granted Pioche shippers on ores of higher grades. This reduction will become effective May 20. The arrangement will expire on Nov. 15, 1921, unless an extension is granted, which seems probable. The reductions are shown as follows:

Valuation	Present Rate	Rate Effective May 20
$10 to $15	$4.25	$3.75
15 to 20	5.50	4.50
20 to 25	7.00	5.50
25 to 30	7.00	6.00

Tule Canyor — The Silver Hills Mining Co. is completing its cyanide plant and expects soon to be able to make a trial run. Recent reports from the property are optimistic, work being done on some small high-grade shoots on the 100 and 200 levels.

ARIZONA

Verde Central Thought To Have Discovered Important Orebody

Jerome—Verde Central is reported locally to have penetrated the edge of an important body of copper ore. The drift is being extended into kaolinized schist and talc that samples above 8 per cent copper in native form, chalcopyrite, and covellite. A width of at least 12 ft. has been demonstrated. The material is soft and crumbling and is believed the capping for a great chalcocite ore chamber. The find was unexpected. It was made in a drift that had been started toward the southeast, at 320 ft. depth, along a slip, from a shaft that had been sunk 200 ft. below the level of the main working tunnel. This tunnel had been extended 1,000 ft. without material results, save in determining the advisability of deeper exploration. Below, quartz had been cut, but little was expected for about 500 ft. more. Recently the drift deviated from the hanging wall to secure better drifting ground, and the next round broke into the orebody.

Verde Central is the old Verde King property of twenty-eight claims, lying on both sides of Hull Canyon, half a mile from the city boundary, adjoining on the south the Cleopatra and Hull and other property of the United Verde Copper Co., with the Verde Apex on the east and the Boston-Jerome on the west.

United Verde Extension suspended smelter operations May 1, putting the operating force at work relining the reverberatory and on improvement. At the mine 200 men have been retained on construction and maintenance work.

United Verde on May 1 reduced wages of all employees who have received above $3.50 a day by 60c., and that of others by 40c.

Dundee-Arizona is exploring on the 950 level, intending to crosscut north and south to the boundaries. In the surface carbonate orebody 2,730 ft. of work has been done, with development of about 70,000 tons of ore averaging above 4 per cent copper. Leaching tests have been made by Joseph Irving, of Bisbee, who recommends installing a test leaching plant. This ore was being studied at the Humboldt plant of the Consolidated Arizona Smelting Co. before that company's shutdown.

Globe—In the Inspiration annual report note is made of a subscription of $60,000 to the stock of the Apache Powder Co., which, under the management of C. E. Mills, is building a dynamite factory near Benson, Ariz.

F. W. Maclennan, general manager of the Miami Copper Co., has announced a reduction of 65c. a shift for underground and 40c. for surface labor. About 1,200 men are still employed by the company, which continues to operate its mine and concentrator. Old Dominion also has posted a lower wage scale, bringing miners down to $4.50 a shift.

Mayer—Interests connected with the Farmers' Savings Bank of Bernard, Iowa, are reported about to resume production from the Buckeye O'Neill onyx quarries, adjoining the Mayer townsite. The material is of notably beautiful marking and clear texture, but its sale has been handicapped by high freight costs. Black onyx has been found on the Mogollon plateau, southeast of Flagstaff, by W. W. Durham and John Marshall.

All buildings except the engine house around the shaft of the Blue Bell mine of the Consolidated Arizona Smelting Co. have been burned. Within the past six months three fires have occurred, all believed to have been of incendiary origin.

Winslow—The Colorado Fuel & Iron Co., of Pueblo, represented by L. B. Weed, is reported to be financing development of a hematite iron body, on the Apache reservation, sixty miles south of Winslow.

Wickenburg—Eight miles southeast of this point a vanadium deposit is being developed on which a 100-ton mill has been erected by the Consolidated Vanadium Co., which now has ready a refining plant in Los Angeles.

UTAH

Silver King Consolidated To Consider Advisability of Venturing in Oil

Eureka—At the Gemini a strike of importance is reported to have been made by a lessee. Underground operations were slowed up recently for a day or two to permit of the installation of a new cable.

Stockholders of the Eureka Lilly met May 5 to consider the establishment of vertical sideline agreements with its neighbors, the Tintic Standard and the Provo. Action will also be taken in regard to partitioning claims held in common with the Tintic Standard.

Park City—The annual stockholders' meeting of the Silver King Coalition will be held May 16. At this time the question of undertaking oil operations will be considered. A dividend of 15c. a share was paid May 1. This amounted to $187,500.

MONTANA

Anaconda Reopens Nettie and Anselmo Mines for Silver-Zinc Ore—W. H. Jahn Elected Tuolumne's President

Butte—Anaconda resumed the mining of silver-zinc ore on May 5 on a limited scale, reopening the Nettie and Anselmo mines and taking silver-zinc-lead ore from the Hibernia property of the Davis-Daly company and silver ore from the Tuolumne company. Employment will be afforded to about 500 men. A portion of the Washoe Reduction Works will be started with ore milled there and smelted at Great Falls. Anaconda will have a zinc output of 2,000,000 lb. monthly derived from the treatment of silver ore.

William H. Jahn, of Milwaukee, has been elected president of the Tuolumne Copper Mining Co., succeeding Edward Hickey, deceased. Mr. Jahn was formerly president of the Pilot-Butte and is president of a patent leather and glove company in Milwaukee.

Neihart — The concentrator of the Cascade Silver was destroyed by fire last week, entailing a loss of approximately $150,000, a portion of this amount being covered by insurance. The future plans of the company have not been announced.

IDAHO

Armstead Mine To Have Mill This Year —May Treat Custom Ores

Talache — Definite assurance has been given that the concentrator planned for the Armstead mine will be built this year. It is indicated that the plant may be planned for handling of custom ore as well as the Armstead mine output.

Bonner's Ferry — Sluicing on the property of Idaho Gold & Ruby Co., at Leonia, is well under way, with three giants in operation. The final unit of construction, the concentrator, for treatment of material gathered from sluicing through the bed-rock flume, will be completed this summer.

Hailey—The Bunker Hill Mining & Concentrating Co. will proceed with extensive operations on the Mayflower-Bullion mine, seven miles from Hailey, and it is understood that equipment will be on the ground soon.

WASHINGTON

Four Metals Co. To Build New Mill at Oroville

Keller—Power plants are to be installed at the Jannot and Bonanza mines, in the Meadow Creek section, this spring. Equipment is arriving, but some road construction and camp building will have to be undertaken before things are in condition for operations. It is hoped to have everything ready

for active underground development by fall.

Seattle—The directors of the Pioneer Mining & Ditch Co., owning valuable Alaskan placer properties, were prevented from considering the resignation of R. H. Cross, an attorney, from the board, through an injunction action in which Cross said the resignation was forced by threats against his life by Jafet Lindeberg. For years Mr. Lindeberg has been prominently identified with mining activity in Alaska. The action arose from the alleged objectionable activities of Lindeberg and W. H. Metson, an attorney, in which Lindeberg obtained the position of manager of the company's properties, and Metson was named attorney. Metson states that the difficult arose out of differences between the company and E. O. Lindblom, Alaska and San Francisco capitalist. Cross is Lindblom's attorney.

Oroville — Directors of the Four Metals Co. have decided to replace the present mill, built in 1919, with a complete modern concentrator, to be designed and built by G. A. King, designer of the Ruby mill, near Nighthawk. The old mill was not adapted to handling the mine output, and therefore represents so much loss to the company.

Spokane—At the annual meeting on May 3 of shareholders of the Standard Silver-Lead Mining Co., operating the Standard mine, at Silverton, Slocan district, British Columbia, the old directorate and officers were re-elected. The financial report showed the company to be in strong position, with a cash surplus in excess of $360,000.

MICHIGAN

Marquette Range

Oliver Company's Section 16 Mine First To Ship From Range

Ishpeming—The Oliver company is moving ore from its Section 16 mine, being the first shipper on the range this season. Ore hoisted is loaded direct, and one shovel is at work on the stockpile.

Palmer—The Steel & Tube Co. has stopped mining at the Isabella mine. The Twenty mine will continue underground exploratory and development work.

Menominee Range

Todd - Stambaugh's Zimmerman Mine Suspends

Iron River—The Zimmerman mine, operated by Todd-Stambaugh, has suspended. Pumping is being continued. One of the Davidson shafts has been closed and operation curtailed. All mines of the Verona Mining Co. are down except the Baltic and Fogarty, which are working small crews half time. The Wickwire company is working the Homer, Delta and Cardiff. The Homer is the only large producer of the three, the others being in the development stage.

Florence—The Florence and Ernst mines are operating with reduced forces on a five-day schedule. Wages have been lowered 10 per cent. These are the only two operating mines on the Wisconsin side of the range.

MINNESOTA

Mesabi Range

Boeing Mine Shuts Down—Mississippi Pumps Pulled

Ely—Ore is being shipped from shaft and stockpile at the Zenith mine, operated by the Vermillion Mining Co. Shipments from the Oliver properties have already gone to the docks.

Biwabik—The Belgrade mine, of the Pickands Mather company, has shipped its first ore of the season from stockpile. Cars are also being loaded at the shaft.

Keewatin—The pumps in the Mississippi are to be pulled by the Pickands Mather company. This property has been closed for some time.

Hibbing—The Oliver Iron Mining Co. began loading iron ore for shipment at its various properties on May 5. Ten mines on the Mesabi have begun shipments, namely, the Hull-Rust, Sweeney, Burt-Sellers, Morris, Philbin, Clark, Chisholm, Chester, Wellington and part of the Missabi Mountain pit at Virginia.

The wage cut announced last week by the Steel Corporation affects many on the Mesabi. Some companies also that reduced wages for day labor several months ago cut salaries 10 per cent May 1.

The Boeing mine, of the Mesaba-Cliffs company, was closed April 30 owing to lack of demand for bessemer ore. Stripping will continue.

ALABAMA

Gulf States' Shannon Mine Producing 400 Tons Daily

Birmingham—The Shannon mine, the first of the deep ore mining projects in Alabama and the property of the Gulf States Steel Co., is producing 400 tons of ore daily. The workings are down over 2,700 ft. Charles A. Moffett, recently elected president of the company, asserts that its ore reserves are, in the Shannon mine alone, sufficient for many years, even if the consumption of the Gulf States should be doubled or increased fourfold. The blast furnace of the company resumed operations May 8.

Independent ore mining properties in Alabama are idle, with pig-iron production at a minimum. Only eight blast furnaces are in operation in Alabama, three independent companies' furnaces on foundry iron and the Tennessee Coal, Iron & Railroad Co., (Steel Corporation) with five at Ensley on basic iron. The Gulf States company was making basic iron the past week, increasing the total number of furnaces running in the state to nine.

The fact that no mention has been made lately of the project of building a gravity aërial railway from the mines on Red Mountain to the blast furnaces of the Tennessee Coal, Iron & Railroad Co. at Ensley, a distance of about eight or ten miles, does not mean that the proposition has been abandoned.

CHRONOLOGY OF MINING

April, 1921

April 1—Anaconda, Calumet & Hecla, Phelps Dodge Corporation's Burro Mountain Branch, and a number of other copper companies closed down. Wage cuts were put into effect in many camps—A law requiring prompt settlements with mining lessees by lessors went into effect in Montana.

April 2—Mineral Separation North American Corporation's argument for admission as party plaintiff against Miami Copper Co. was heard at Wilmington, Del.

April 3—Colorado School of Mines administration vindicated by report of the State Assembly's committee.

April 4—U. S. Assay office completed occupation of new building at 25 Wall St., New York.

April 5—International Mining Convention held third annual session at Portland, Ore.

April 6—American Smelting & Refining Co. stockholders at annual meeting re-elected the Guggenheim board of directors.

April 11—Iron-ore shipping season on Great Lakes opened at Duluth, Minn. Minnesota occupational tax bill signed, laying 6 per cent tax on ores mined in state.—Silver King Coalition Mines Co., Park City, Utah, awarded extra-lateral rights in Conkling claim, by U. S. Supreme Court.

April 12—Utah Copper Co.'s concentrator at Garfield, Utah, closed down.—Newly elected directors of A. S. & R. Co. met, and adopted the Guggenheim slate.

April 15—New York & Honduras Rosario Mining Co. suspended operations temporarily.—Gold mining companies on Mother Lode, California, announced a 50c. wage cut.—International Nickel Co. cut wages 15 per cent.—American Association of Engineers held second annual southwestern convention at Phoenix, Ariz.—Apache Indian Reservation, Globe, Ariz., opened to location for asbestos.

April 16—Herbert Hoover resigned as chairman of American Engineering Council.—H. Foster Bain renominated as Director of U. S. Bureau of Mines.—Miners and mill men strike at Tonopah and Divide, Nev., following 75c. wage cut.

April 20—Bonner County Mining Association held first annual meeting at Sandpoint, Idaho.

April 21 — Methane explosion in Cyclops Tunnel, Blackhawk, Col., injured two.

April 22 — Eagle-Picher Lead Co. closed mines.

April 28—Senator Pittman (Nev.) addressed the Mining and Metallurgical Society of America on future of the Pittman Act.

April 29—Western Pacific R.R. put into effect new freight rates from Utah and Nevada points to Oakland, Cal.

April 30—Granby Consolidated M. S. & P. Co. closed Grand Forks, B. C., plant.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
5	12.375	31.75	33.00	4.85@5.00	4.70@4.75	4.95
6	12.35@12.50	32.00	33.00	4.90@5.00	4.75	4.95
7	12.35@12.50	31.75	33.00	4.90@5.00	4.75	4.95@4.90
9	12.50	31.50	32.50	5.00	4.75@4.85	4.90
10	12.50	31.25	32.25	5.00@5.20	4.85@5.00	4.90
11	12.50@12.75	31.75	33.00	5.00@5.20	4.90@5.00	4.90

*These prices correspond to the following quotations for copper, "delivered": 12.625; 12.60@12.75; 12.60@12.75; 12.75; 12.75; and 12.75@13c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
5	72½	70½	72¾	176	178½	22½	22½	26	27¼
6	72½	71	72½	177½	179¾	22¾	22⅝	26	27¼
7	...	...	...	...	...	...	...	...	...
9	72¼	71¼	73	176	178	24	24	26	27½
10	72	71	73	173½	175¾	24	24	26	27¼
11	72	71¼	73½	178½	180¼	24⅜	24	26¼	27¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange	Silver			May	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
5	397	99¼	61⅞	35¼	9	397⅞	99¼	61⅝	35⅛
6	396⅞	99¼	60¾	34¾	10	398½	99¼	61⅜	35
7	397⅛	99¼	62½	35½	11	398⅜	99¼	60½	34½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Metal Markets

New York, May 11, 1921

Copper and lead are much firmer this week; tin is virtually unchanged; and zinc, as a result of an almost total cessation of demand, is weaker. The domestic market is still governed by European conditions to a large extent, foreign demand for copper strengthening the price here, and the local price of lead being advanced because of the fact that no importations threaten at current New York and London levels. The acceptance by Germany of the Allied demands is considered to be most encouraging and is likely to have a buoyant effect on metal prices as well as foreign exchange.

Copper

The feeling among copper producers is much better, although domestic demand is still small. Foreign business during the week was excellent, in volume if not in price, and was sufficient to absorb all of the metal which otherwise would have exerted a pressure on the domestic market. The Copper Export Association is understood to have done most of its business with France and Germany at 13c. delivered, equivalent to about 12.50@12.625c. f.o.b. refinery. Outside interests sold a good tonnage to British metal dealers at slightly lower prices. Most producers are now holding their copper firmly at 13c. for May and June, and 13.25c. for third-quarter business, although several are not willing to book any forward business even at this figure.

One underlying element in the copper situation that is continually gaining strength, and which has kept followers of the market optimistic, is the effect of curtailment of production. Although a complete cessation of output, even by those companies which have announced a shutdown, has not yet been accomplished, comparative estimates indicate that mine production of copper in the United States, Alaska, and in American properties in South America, for twenty-two representative companies, will soon be at the rate of but little more than 21 per cent of the 1920 production. That is, whereas these important copper producers turned out 1,276,000,000 lb. of copper in 1920, their annual rate by the end of this month will amount to only 273,000,000 lb. In the meantime the demand has every prospect of increasing.

Lead

The A. S. & R. Co. advanced its official contract price of lead from 4.75 to 5c., New York and St. Louis, on Tuesday, May 10.

The total volume of lead sold during the last week has not been quite as great as in several recent weeks, but, nevertheless, the inquiries, aided by a sold-up condition on the part of most producers and a stiff week-end advance in London, caused the 5c. level to be reached and passed in the New York market. A feature of the business has been the insistent demand, from large consumers, for lead for immediate shipment, indicating that they have practically no stocks on hand. Electric and cable interests have possibly been the most active factors in the market.

One large producer selling in St. Louis who has not been in the market for six months or so, and has been quietly accumulating stocks for higher prices, is now freely offering at 5c. This should stabilize the St. Louis price at that figure, although it would not prevent the New York price from going to 5.50c., as the freight is approximately one-half cent between the two cities. Chemical lead in the West is now practically on a par with other kinds, although a premium, due to the freight, is asked in the East.

Zinc

The market is softer, and zinc is freely offered at 4.90c., East St. Louis. Trading has been quiet and in small volume, some of the largest producers recording but few sales. Demand for the metal has seemingly evaporated, but, at the same time, many producers are unwilling to sell at the 4.90c. price. Unlike other metals, zinc seems unable to retain the gains of the last few

weeks, possibly because of the weaker financial position of some operators. No interest is reported in forward deliveries.

Tin

Tin was stronger on Thursday and Friday, weaker on Monday, and firmer again today. One sale of 99 per cent was made yesterday at 30.50c., but the seller is believed to have been misinformed regarding conditions, as this price was considerably below the market. Electrolytic has been in fair demand at ⅛@¼c. less than Straits. We quote tin for forward delivery at ¼c. less than the price for spot Straits for the week.

Arrivals of tin, in long tons: May 7th, Straits, 50; 9th, Liverpool, 25.

Gold

Gold in London: May 5th, 103s. 4d.; 6th, 103s. 4d.; 9th, 103s. 3d.; 10th, 103s. 2d.; 11th, 102s. 11d.

Foreign Exchange

Foreign exchange has generally shown a stronger tendency during the last week. On Tuesday, May 10th, francs were 8.38c.; lire, 5.175c.; and marks, 1.56c. New York funds in Montreal, 10⅛ per cent premium.

Silver

The silver market of late has been erratic, jumping to 35½d. in London on May 7, on speculative buying, but reacting on selling by Indian bazaars. The market is narrow, and owing to limited supplies moves sharply up or down on buying or selling orders. Renewal of Continental sales of coin silver has caused the market to close weaker in London at 34½d. The New York market has followed the London price, owing to lack of China buying, and closes dull with tendency uncertain.

Mexican Dollars—May 5th, 47½; 6th, 46⅝; 7th, 48; 9th, 47¼; 10th, 47; 11th, 46½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—List prices of 28@28.5c. are nominal. Outside market, 22@23c. per lb.; 22½c. for imports, duty paid.

Antimony — Chinese and Japanese brands, 5¼@5⅝c.; market dull. W.C.C. brand, 5⅞@6¼c. per lb. Cookson's "C" grade, spot, 9⅜c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Bismuth—$1.50@$1.60 per lb., 500-lb. lots.

Cadmium—Nominal, $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt—Metal, $4 per lb.; black oxide, $3@$3.10 per lb. in bbls.; sulphate, $1.35 per lb. in bbls.

Iridium—Nominal, $250@$300 per oz.

[1]Molybdenum Metal in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 38@40c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70@$80 per troy oz.

Palladium—$65@$70 per oz.

Platinum—$72@$75 per oz.

Quicksilver—Nominally, $46@$48 per 75-lb. flask. San Francisco wires $48.50.

[1]Rhodium—$200@$225 per troy oz.

Ruthenium—$175@$200 per troy oz.

[1]Selenium—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]Thallium Metal—Ingot, 99 per cent pure, $20 per lb.

[1]Tungsten Metal—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Guaranteed 50 per cent Cr_2O_3 foreign ore with a maximum of 6 per cent silica, 45@55c. per long ton unit, f.o.b. Atlantic ports.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $7.45; Mesabi bessemer, 55 per cent iron, $7.20; Old Range non-bessemer, 51½ per cent iron, $6.70; Mesabi non-bessemer, 51½ per cent iron, $6.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5.80; old bed concentrates, 63 per cent, $6.70; Harmony, cobbed, 63 per cent, $6.70; new bed low phosphorus, 65 per cent, $9.50.

Manganese Ore—25@30c. per unit, seaport; chemical ore (MnO_2) $55@$60 per gross ton, lump; $70@$75 per net ton, powdered.

Molybdenum Ore—85 per cent MoS_2, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]Titanium Ores—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO_3 and over, per unit of WO_3 $3@$3.75, f.o.b. Atlantic ports.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1.50 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York.

[1]Zircon—Washed, iron free, 3c. per lb.

[1]Zirkite—According to conditions, $70@$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa

Zinc and Lead Ore Markets

Joplin, Mo., May 7—Zinc blende, per ton, high, $26.70; basis 60 per cent zinc, premium, $26.50; Prime Western, $26@$25; fines and slimes, $23@$21; average settling price, all zinc ores, $23.62.

Lead, high, $56.10; basis 80 per cent lead, $57.50; average settling price, all lead ores, $53.46 per ton.

Shipments for the week: Blende, 5,337; lead, 1,535 tons. Value, all ores the week, $209,780. Some sellers are asking $27.50 basis Prime Western and are holding their ore. With this tonnage reserved from the market, buyers are getting only around 4,000 tons per week, with a demand for 4,500 to 5,000 tons. With the reserve of slab zinc diminishing, sellers are expecting the metal market to advance soon, with a favorable reaction on ore. Three blocks were closed down at one Henryetta, Okla., smelter last week, and this will reduce the supply of slab zinc.

Platteville, Wis., May 7—Ore price, $27.50 for 60 per cent zinc, and $52 for 80 per cent lead ore, but operators refused to sell. Shipments for week: Blende, 41; lead ore, 109 tons. Shipments for the year: Blende, 11,461; lead ore, 659 tons. Shipped during the week to separating plants, 715 tons blende.

Non-Metallic Minerals

Asbestos — Crude, No. 1, $2,000@$3,000; No. 2, $1,400@$2,000; spinning fibres, $400@$1,000; magnesia and compressed sheet fibres, $325@$500; shingle stock, $110@$150; paper stock, $60@$75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

Barytes—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, $25 per net ton f.o.b. Atlantic seaports. Western grades are $24.50. Crude quoted $7 per long ton, f.o.b. Cartersville, Ga. Small lots as low as $5.

Bauxite—High-grade French bauxite, $8@$10 per ton, Atlantic ports. American quotations the same. Consumers generally well supplied. Prices vary according to grade. Crude, unground, $16.50 per ton; ground, $22; calcined, ground $35; unground, $45, f.o.b. plant.

Chalk—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $8@$10; washed, $10@$12; powdered, $15@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $15@$20, f.o.b. Virginia points. Domestic lump, $10@$20; powdered, $25@$30; imported lump, $15@$25, f.o.b. American ports; powdered, $35@$45, f.o.b. New York.

Emery—Turkish emery, 6@6½c. per lb., depending upon fineness. Inferior grades, 3½c. f.o.b. New England points.

Feldspar—Crude, $8@$14 per gross ton, f.o.b. Maryland and North Carolina points; $7.50@$10, f.o.b. Maine; ground, $27@$30, car lots, f.o.b. Baltimore; ground, $17@$21, f.o.b. North Carolina points; $17@$21 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$25 per ton, f.o.b. Illinois and Kentucky mines; acid, glass, and enamel grades, $40@$55; ground, suitable for acid, chemical or enameling purposes, $32@$35; lump, $15, f.o.b. Lordsburg, N. M. Ground acid grade, 97 per cent CaF_2, $32, New Mexico, Canadian price generally $18 (Canadian currency) per ton, f.o.b. mines. Market is improving in western ground acid grades for glass and enamel manufacture.

Fuller's Earth—16 to 30 mesh, $21; 30 to 60 mesh, $23; 60 to 100 mesh, $19; 100 plus mesh, $15, f.o.b. plants, Pennsylvania. California grades, $15@$25, f.o.b. mines. Imported, English, $24@$27, f.o.b. Atlantic ports.

Graphite—Ceylon lump, first quality, 7½@8c. per lb.; chip, 6@6½c.; dust, 4@4½c. No. 1 flake, 7c.; amorphous crude, ¾c.@2½c.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, $3.50@$4.50; calcined stucco, $9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.40@$2 per net ton; 1½ in., $1.50@$2. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined—Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $56 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $38 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $55@$60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, quoted $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $12.50; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $7.35; 68 per cent, $6.85; 68@66 per cent, $6.60.

[1]Foote Mineral Co., Philadelphia, Pa.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 14c., c.i.f. Atlantic seaport; furnace size, 14c.; Spanish lump, 12@14c.; domestic fines, f.o.b. mines, Georgia, 12 @ 14c.

Silica — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

Sulphur—$18 per ton for domestic; $18@$20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

Talc—Paper making, $11@$20 per ton; roofing grades, $8.50@$13; rubber grades, $11@$18; all f.o.b. Vermont. California talc, $18@$40, talcum powder grade. Southern talc, powdered, carload lots, $10@$14 per ton; less than carload, $25, f.o.b. cars. Imported, $35@$40; Canadian, $20@$40 per ton.

Mineral Products

Arsenic—White arsenic, 7¾@8c. per lb. in carload lots.

Sodium Nitrate—$2.75@$3 per cwt. ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; $33@$35 per ton, New York.

Potassium Sulphate—Powder, domestic, $1.75@$1.80 per unit, basis 90 per cent, f.o.b. New York.

Ferro Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 15c. per lb. of chromium contained; 4 to 6 per cent carbon, 16@17c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, $83@$85, f.o.b. furnace; resale, $90, delivered; English, $83@$85, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, $32, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $50@$55; 50 per cent, $80@$85; 75 per cent, $145@$150.

Ferrotungsten—Domestic, 70 to 80 per cent W, 50@55c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$5@$6 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 20½@20¾c. per lb.; wire, 15c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver — 33½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets 18¼c.; sheathing, 17¼c.; rods, ⅝ to 3 in., 15¼c.

Zinc Sheets—$11 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 10c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, $35@$50 per ton, f.o.b. works.

Chrome Cement—40@45 per cent Cr_2O_3, $45@$50 per net ton, and $55 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—Straights, $75 per net ton, shipping point; arches, keys, wedges, $80; splits, soaps, $90.

Fire Brick—First quality, 9-in. shapes, $40@$50 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, $40@$50.

Magnesite Brick—9-in. straights, $90@$95 per net ton; 9-in. arches, wedges and keys, $100; soaps and splits, $110.

Silica Brick—9-in., per 1,000: $45@$55 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, May 10, 1921

From the partial report of steel ingot production in April made by the American Iron and Steel Institute, interpreted with the aid of certain trade estimates, it is seen that production of steel in April was at 30 or 31 per cent of capacity, the Steel Corporation probably producing at 40 or 41 per cent and the independents at 22 or 23 per cent. Thus far this month the industry's rate has been approximately the same, but the difference between the Steel Corporation and independent rates has narrowed somewhat. No material change from the general rate is to be expected until there is a decided change in fundamental business conditions.

Pig Iron—The $23, Valley, quotation on basic iron has been nominal for several weeks, and the trade regards the market now as $22.50, there having been a few sales at that figure, and $22 is rumored as obtaining in one sale. Bessemer is nominal at $25, Valley, and last week's reduced price of $24 on foundry could possibly be shaded.

Steel—There are scarcely any sales of semi-finished steel, but prices are maintained at $37 for billets, $38 for slabs, $39 for sheet bars and small billets, and $48 for rods.

Coke

Connellsville—Furnace, $3.25@$3.75; foundry, $4.50@$5.

The Principal American Copper-Mining Companies And What Becomes of Their Copper

BY EDWARD H. ROBIE

COPPER commonly passes through four distinct processes before it reaches the manufacturer. First the ore must be mined, then concentrated, then smelted, and lastly the crude copper must be refined, not only to secure the highest efficiency for electrical and other uses, but to remove the precious metals therein contained. As the metal progresses along this scale, the business becomes more and more centralized. There are thousands of mines in the country—if we are not particular what we call a mine—hundreds of mills, and scores of smelters, but the refineries can be counted on the fingers and toes if one counts that way. Selling, too, is in the hands of relatively few agencies, almost entirely situated in New York City. There has been no secrecy about the various channels through which American copper passes, but no reference chart has ever been prepared, so far I know, to give this information in a handy form. As questions regarding the disposal of a certain company's product often come up, the data presented on the reverse side of this page should be valuable.

Under "Name" is given the name of the company which owns the mine or mines, and it was the intention to include all of the more important producers of the Western Hemisphere. In general, companies producing less than a million pounds per year were not considered of sufficient importance to list. Doubtless some companies whose production normally exceeds this figure have been omitted, however, as information concerning many Mexican and South American companies is scanty. Compilation of the list has been aided by reference to Weed's "The Mines Handbook." The name generally given is that of the controlling interest rather than that of the subsidiary operating company.

The second column is intended to give the approximate production in millions of pounds for 1920, or, if the property did not operate throughout the year, for the last full year of operation. The production figure represents only the copper produced from the company's own mines, and does not include custom business or copper produced by subsidiary companies which is otherwise reported. The figure is intended to represent the amount of refined copper finally recovered. This and the information given in succeeding columns was in most cases courteously supplied by the individual companies.

The third column, "Mills," usually implies a concentrator, although in some operations, notably those of Chile, New Cornelia, and Kennecott, the ore is wholly or in part leached, thereby eliminating concentrating and smelting. Further particulars as to smelting and refining equipment may be found in the *Engineering and Mining Journal* for Jan. 17, 1920, p. 117.

Selling agencies occasionally change, but, so far as is known, the chart shows the arrangement now in effect, or which was in effect when the property in question closed down, if it be now closed. In addition to the names given, the Copper Export Association, New York, sells the copper of many producers to foreign buyers. A list of such producers is given on pp. 84 to 87, inclusive, of "The Mines Handbook" for 1920. In a few instances there is no regular selling agency, but matte or concentrates are sold in the market to the highest bidder.

By far the largest tonnage of copper is marketed by Guggenheim Bros., representing the Hayden-Stone-Jackling interests, this agency being the outlet of about 500,000,000 lb. annually at last year's rate of production. This is largely from the so-called porphyries, and from Chile, the largest producer of them all. Until 1920 all of this copper was sold through the American Smelting & Refining Co. Second comes the United Metals Selling Co., representing the Rockefeller-Ryan-Anaconda group, with about 350,000,000 lb., chiefly from Montana. Third, the Phelps Dodge Corporation, whose properties are in the Southwest, with about 200,000,000 lb. Fourth, the American Metal Co., which owns no copper mines of importance, but which is an active selling interest, and is the outlet for about 150,000,000 lb. at the 1920 rate. Fifth is the Calumet & Hecla Co., the largest of the Michigan native copper producers, with about 100,000,000 lb. to market.

To indicate those properties now closed down has been found impossible in view of the wholesale curtailments and suspensions made in the last few months. Some of those companies which are known to have been closed down at the first of the year are indicated, but there are doubtless others. So far as known, no "dead" companies—those which do not expect to resume operations unless copper gets back to 35c.—are included.

Copper is not sold by brand to the extent that zinc, tin and lead are. This applies particularly to electrolytic copper, which varies little in purity. Furthermore, the product of any refinery is usually made from a mixture of blister from various sources which are constantly changing. Often the purest copper is used for casting wire bars because of the particularly deleterious effects of slight impurities on electrical conductivity. The following list, compiled from "Metal Statistics, 1921" shows the producer and brand of most of the copper marketed in this country.

BRANDS OF COPPER

Lake

Ahmeek	T.O.
Allouez	T.O.
Calumet & Hecla	C.L.; T.O.; C.&H.M.Co.
Lake Superior Smelting Co.	S.R.
Copper Range	C.R.
Franklin	F.M.Co.
La Salle	S.R.
Mass.	Mass.
Michigan	M.C.
Mohawk	M.M.
Osceola	T.O.
Quincy	Q.M.Co.
Superior	S.R.
Victoria	V.C.
White Pine	S.R.
Winona	W.A.
Wolverine	W.

Electrolytic

American Smelting & Refining Co.	P.A.
American Smelters Securities Co.	Tacoma
Anaconda Copper Co.	B.M.
Arizona Copper Co.	A.C.C.
Balbach Smelting & Refining Co.	Bb.
Baltimore Copper S. & R. Co., (A.S. & R.Co.)	B.E.R.
Boston & Montana Co., (Anaconda)	B.&M.
Chile Copper Co.	C.C.C.
Denn Arizona Copper Co.	A.L.S.
East Butte Copper Mining Co.	Pittsmont
Granby Consolidated Mining & Smelting Co.	L.N.S.
Lake Superior Smelting Co.	T.O.
Miami Copper Co.	N.E.C.
Missouri Cobalt Co.	M.C.Co.
Nichols Copper Co.	Triangle; L.N.S.
Orford Copper Co. (International Nickel)	O.E.C.
Phelps Dodge Corporation	C. *Q.
Raritan Copper Works (Anaconda)	N.E.C.; A.B.S.
Shattuck Arizona Copper Co.	A.L.S.
U. S. Metals Refining Co.	D.R.W.
White Pine, Superior, La Salle	S.R.

Casting

Balbach Smelting & Refining Co.	N.B.C.
Baltimore Copper S. & R. Co.	B.C.W.
Boston & Montana Co. (Anaconda)	M.A.
Chicago Copper Refining Co.	C.C.R.
Duquesne Reduction Co.	D.R.C.
Nichols Copper Co.	C.N.C.
Phelps Dodge Corporation	P.D.Co.
Tottenville Copper Co.	C.T.C.
U. S. Metals Refining Co.	D.S.
White & Bros., Inc.	C.C.

In some cases the copper is secondary metal, and the producer is therefore not given in the chart on the next page (p. 848).

Principal American Copper-Mining Companies and What Becomes of Their Copper

Name	Approx. 1920 Prod. in Mil. Lb.	Mill	Smelter	Refinery	Selling Agency
Afterthought Copper Co (*c*)	..	Afterthought, Ingot, Cal	Afterthought, Ingot, Cal	American Smelting & Refining Co. Tacoma, Wash.	American Smelting & Refining Co , New York
Ahmeek Mng. Co	20	Ahmeek, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla Co., New York
Alloues Mng. Co	2	Lake M. S. & R., Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla Co., New York
American Smg. & Ref. Co	11	Various, Chiefly in Mexico	Various A. S. & R. in Mex , Tex., Utah, Ariz , Wash , Neb , N. J	A. S. & R., Baltimore, Md.; Tacoma, Wash.; Maurer, N. J	American Smelting & Refining Co., New York
Anaconda Cop. Mng. Co	109	Anaconda, Anaconda, Mont	Anaconda (Washoe), Anaconda, Mont	Anaconda, Great Falls, Mont., Perth Amboy, N. J.	United Metals Selling Co., New York
Arizona Commercial Mining Co	8	Old Dominion, Globe, Ariz	Int. Smg. Co., Miami, Ariz. & Old Dominion, Globe	Anaconda, Perth Amboy, N. J.; Nichols Copper Co., Laurel Hill, N. Y	Phelps Dodge Corporation, New York
Arizona Copper Co	35	Ariz. Cop., Morenci, Ariz	Ariz. Cop., Clifton, Ariz	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J	United Metals Selling Co., New York
Backus & Johnston (*d*)	18	B. & J., Casapalca, Peru	B. & J., Casapalca, Peru	U. S. Metals Ref. Co., Chrome, N. J	American Metal Co., New York
Bleo Co	10	None	Boleo, Santa Rosalia, Baja Cal., Mex	American Smelting & Refining Co., Tacoma, Wash.	American Smelting & Refining Co., New York
Braden Copper Co	65	Braden, Sewell, Chile	Braden, Sewell, Chile	American Smelting & Refining Co., Baltimore, Md.	Guggenheim Bros., New York
British Amer. Nickel Corp. ( )	1	None	B. A. N. Corp., Nickelton, Ont., Canada	B. A. N. Corp., Deschenes, Que., Canada	B. A. Nickel Corp., Ottawa, Canada
Calumet & Arizona Mining Co	42	In part by C. & A., Lordsburg, N. M	Calumet & Arizona, Douglas, Ariz	Nichols Copper Co., Laurel Hill, N. Y	Phelps Dodge Corporation, New York
Calumet & Hecla Mining Co	58	C. & H., Lake Linden, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla Co., New York
Canada Copper Corporation (*c*) (*x*)	20	C. C. C., Allenby, B. C., Canada	Consol. Mng. & Smg. Co., Trail, B. C., Canada	Con. M. & S. Co., Trail, B. C., Canada	Consolidated M. & S. Co., Montreal
Catemou: Soc. d. Mines, d. C. ( ) (*d*)	9	Catemou, La Poza and Chagres, Chile	Catemou, La Poza and Chagres, Chile	U. S. Metals Refining Co., Chrome, N. J	American Metal Co., New York
Centennial Copper Mining Co	1	Lake M. S. & R., Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, New York
Central Chile Copper Co. (*x*) (*b*) ( )	4	None	Central C. C. Co., Panuncillo, Chile	Various	Matte sold to various buyers
Cerro de Pasco Copper Corporation (*d*)	52	None	Cerro de Pasco, La Fundicion, Peru	U. S. Metals Ref. Co., Chrome, N. J	American Metal Co., New York
Champion Copper Co	14	Champion, Freda, Mich	Michigan Smelting Co., Houghton, Mich	Michigan Smelting Co., Houghton, Mich	Copper Range Co., New York
Chile Copper Co	111	Chile C. C., Chuquicamata, Chile	None	Chile Copper Co., Chuquicamata, Chile	Guggenheim Bros., New York
Chino Copper Co	44	Chino, Hurley, New Mexico	American Smelting & Refining Co., El Paso, Tex.	American Smelting & Refining Co., Baltimore, Md.	Guggenheim Bros., New York
Consolidated Arizona Smelting Co. (*x*) (*d*)	9	Con. Ariz., Humboldt, Ariz	Consolidated Ariz., Humboldt, Ariz	U. S. Metals Refining Co., Chrome, N. J	American Metal Co., New York
Consolidated Coppermines Co. (*x*) (*b*)	16	Consolidated Copperminos, Kimberly, Nev	Nevada Con., McGill, Nev	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J	United Metals Selling Co., New York
Consolidated Mining & Smelting Co	1	C. M. & S., Trail, B. C., Canada	C. M. & S., Trail, B. C., Canada	Consol. M. & S. Co., Trail, B. C	Consolidated M. & S. Co., Montreal
Copper Range Co	7	C. R., Redridge, Mich	Michigan Smelting Co., Houghton, Mich	Michigan Smelting Co., Houghton, Mich	Copper Range Co., New York
Corocoro United Copper Mines	15	Corocoro, Le Paz, Bolivia	A. S. & R. Tacoma, Wash. and at Liverpool, Eng.	Various	Corocoro U. C. M., Paris
Davis-Daly Copper Co	9	None	East Butte, Butte, Mont	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J	W. P. Todd, New York
Democrata Can. Son. Copper Co	3	Democrata Can., Cananea, Son., Mex	Democrata, Can., Cananea, Son., Mexico	U. S. Metals Ref. Co., Chrome, N. J	American Metal Co., New York
Ducktown Sulphur, Copper & Iron Co.	6	Ducktown, Isabella, Tenn	Ducktown, Isabella, Tenn	Nichols Copper Co., Laurel Hill, N. Y	Nichols Copper Co., New York
East Butte Copper Mining Co	8	East Butte, Butte, Mont	East Butte, Butte, Mont	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J	W. P. Todd, New York
Engels Copper Co. (*d*)	9	Engels, Engelmine, Cal	American Smelting & Refining Co., Garfield, Utah	A. S. & R. Co., Baltimore or Maurer, N. J	American Smelting & Refining Co., New York
Franklin Mining Co. (*x*) (*a*)	1	Franklin, Point Mills, Mich	Michigan Smelting Co., Houghton, Mich	Michigan Smelting Co., Houghton, Mich	Franklin Mining Co., Boston
Gila Copper Sulphide Co. (*d*)	..	None	American Smelting & Refining Co., Hayden, Ariz	A. S. & R. Co , Baltimore or Maurer, N J	American Smelting & Refining Co., New York
Granby Consolidated M. S. & P. Co	27	None	Granby, Anyox, B. C., Canada	Nichols Copper Co., Laurel Hill, N. Y	American Metal Co., New York
Greene-Cananea Copper Co ( )	44	Greene-Cananea, Cananea, Son., Mexico	Greene-Cananea, Cananea, Son., Mexico	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J	United Metals Selling Co., New York
Hancock Consolidated Mining Co. (*b*)	4	Lake M. S. & R. Co., Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla Co., New York
Howe Sound Co	18	Howe Sound, Britannia Beach, B. C., Can	American Smelting & Refining Co., Tacoma, Wash.	American Smelting & Refining Co., Tacoma, Wash.	American Smelting & Refining Co., New York
Inspiration Consolidated Copper Co	79	Inspiration, Miami, Ariz	International Smelting Co., Miami, Ariz	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J.	United Metals Selling Co., New York
International Nickel Co	17	None	International Nickel Co., Copper Cliff, Ont., Can.	U. S. Metals Ref. Co., Chrome, N. J	American Metal Co., New York
Iron Cap Copper Co	8	Iron Cap, Copper Hill, Ariz	International Smg. Co., Miami, Ariz	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J.	United Metals Selling Co., New York
Isle Royale Copper Co	11	Isle Royale, Houghton, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, New York
Kennecott Copper Corporation (*d*)	77	Kennecott, Kennecott, Alaska	Amer. Smg. & Ref. Co., Tacoma, Wash	American Smelting & Refining Co., Tacoma, Wash.	Guggenheim Bros., New York
Magma Copper Co	9	Magma, Superior, Ariz	Amer. Smelting & Refining Co., Hayden, Ariz	Amer. Smg. & Ref. Co., Baltimore or Maurer, N. J	Magma Copper Co., New York
Mason Valley Mines Co. (*x*) (*b*)	15	None	Mason Valley, Thompson, Nev	Amer. Smg. & Ref. Co., Baltimore or Maurer, N. J.	Mason Valley Mines Co., New York
Mass Consolidated Mining Co. ( ) (*b*)	3	Mass, Keweenaw Bay, Mich	Quincy, Hancock, Mich	Quincy Smelting Wks., Hancock, Mich	Mass Consol. Mining Co., Boston
Matahambre Mines	14	Matahambre, Pinar del Rio, Cuba	U. S. Metals Refining Co , Chrome, N. J	U. S. Metals Refining Co , Chrome, N. J	American Metal Co., New York
Mazapil Copper Co	6	Mazapil, Saltillo, Coa., Mex	Mazapil, Concepcion del Oro, Coa., Mexico	Amer. Smg. & Ref. Co., Baltimore, Md	Amer. Smelting & Refining Co., New York
Metalurgica Mexicana Cia. ( )	..	..	Metalurgica Mexicana, San Luis Potosi, Mexico	U. S. Metals Refining Co., Chrome, N. J	American Metal Co., New York
Miami Copper Co	56	Miami, Miami, Ariz	International Smelting Co., Miami, Ariz	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J.	Adolph Lewisohn & Sons, New York
Mohawk Mining Co	10	Mohawk, Gay, Mich	Michigan Smelting Co., Houghton, Mich	Michigan Smelting Co., Houghton, Mich	Mohawk Mining Co., New York
Mond Nickel Co	7	None	Mond, Coniston, Ont., Canada	Mond, Clydach, Wales	Mond Nickel Co , London
Mountain Copper Co ( ) ( ) ( )	7	Mountain Copper, Keswick, Cal	Mountain Copper, Martinez, Ca	A. S. & R. Co., Baltimore Md	Jardine Matheson & Co., New York
Naltagua: Soc. d. Mines d. C.	6	None	Soc. d. Mines d. C., Naltagua, Chile	A. S. & R. Co., in U. S. or in France	Soc. d. Mines d. Naltagua, Paris
Nevada Con. Copper Co	48	Nevada Con., McGill, Nev	Nevada Con., McGill, Nev	Am. Sm. & Ref. Co., Baltimore or Maurer, N. J	Guggenheim Bros., New York
New Cornelia Copper Co	40	New Cornelia, Ajo, Ariz	10 per cent Calumet & Ariz., Douglas, Ariz	New Cornelia, Ajo, Ariz	United Metals Selling Co., New York
North Butte Mining Co	16	Anaconda, Anaconda, Mont	Anaconda (Washoe), Anaconda, Mont	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J.	United Metals Selling Co., New York
Ohio Copper Co. (*x*) (*b*) (*d*)	3	Ohio Copper, Lark, Utah	American Smelting & Refining Co., Garfield, Utah	Am. Sm. & Ref. Co., Baltimore or Maurer, N. J	American Smelting & Refining Co., New York
Old Dominion Co	21	Old Dominion, Globe, Ariz	O. D., Globe; and International, Miami, Ariz	Nichols Copper Co., Laurel Hill, N. Y. & Raritan, Perth Amboy, N.J	Phelps Dodge Corporation, New York
Osceola Consolidated Mining Co	7	Osceola, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, New York.
Penn Mining Co. (*x*) (*b*)	3	None	Penn, Campo Seco, Cal	U.S. Metals Refining Co., Chrome, N. J	American Metal Co., New York
Phelps Dodge Corp	95	Various in Ariz., Mex. & New Mex	Phelps Dodge, "Copper Queen," Douglas, Ariz.	Nichols Copper Co., Laurel Hill, N.Y	Phelps Dodge Corporation, New York
Poderosa Mining Co., Ltd	12	Poderosa, Collahuasi, Chile	Various in Chile, U. S. or Great Britain	Various	Company Sells Ore and Concentrates
Quincy Mining Co. (*a*)	19	Quincy, Mason, Mich	Quincy, Hancock, Mich	Quincy, Hancock, Mich	Quincy Mining Co., New York
Ray Consolidated Copper Co	47	Ray Consolidated, Hayden, Ariz	American Smelting & Ref. Co., Hayden Ariz	Amer. Smg. & Ref. Co., Maurer, N. J	Guggenheim Bros., New York
Ray Hercules Copper Co. ( ) (*a*)	5	Ray Hercules, Hercules, Ariz	American Smelting & Refining Co., Hayden, Ariz.	Amer. Smg. & Ref. Co., Maurer, N. J	E. P. Earle, New York
Shattuck-Arizona Copper Co	2	None	Calumet & Arizona, Douglas, Ariz	Nichols Copper Co., Laurel Hill, N. Y	Shattuck Arizona Cop. Co., New York
South American Copper Syndicate (*x*)	..	S. A. C. S., Aroa, Venezuela	S. A. C. S., Aroa, Venezuela	U. S. Metals Ref. Co. Chrome, N. J	H. D. Boret, London
Tennessee Copper & Chem. Corporation	10	None	Tennessee, Copperhill, Tenn	American Smelting & Refining Co., Baltimore, Md.	Adolph Lewisohn & Sons, New York
Trimountain Mining Co	4	Copper Range "Baltic," Redridge, Mich	Michigan Smelting Co., Houghton Mich	Michigan Smelting Co., Houghton, Mich	Copper Range Co., New York
Tuolumne Copper Mining Co	1	Anaconda, Anaconda, Mont	Anaconda (Washoe), Anaconda, Mont	Anaconda, Great Falls, Mont. & Perth Amboy, N.J.	United Metals Selling Co., New York
U. S. Smelting, Ref. & Mng. Co. ( ) (*b*)	6	None	U. S. S. R. & M., Kennett, Cal	U. S. Metals Refining Co., Chrome, N. J	U. S. Smelting, Ref. & Mng. Co., New York
United Verde Copper Co	65	None	United Verde, Clarkdale, Ariz	U. S. Metals Refining Co., Chrome, N. J	American Metal Co., New York U. S. Smelting, Refining & Mining Co., New York
United Verde Ext. Mining Co	42	None	United Verde Ex., Clemenceau, Ariz	Nichols Copper Co., Laurel Hill, N. Y	Phelps Dodge Corporation, New York
Utah Consolidated Mining Co. (*d*)	3	Utah Consolidated, Tooele, Utah	International Smg. Co., Tooele, Utah	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J.	United Metals Selling Co., New York
Utah Copper Co	102	Utah Cop Co Magna and Arthur, Utah	American Smelting & Refining Co., Garfield, Utah	Amer. Smg. & Ref. Co., Baltimore or Maurer, N. J.	Guggenheim Bros., New York
Victoria Copper Mining Co	1	Victoria, Victoria, Mich	Quincy Smelting Works, Hancock, Mich	Quincy Smelting Wks., Hancock, Mich	Calumet & Hecla Co., New York
Walker Mining Co	1	Walker, Portola, Cal	International Smelting Co., Tooele, Utah	Anaconda (Raritan Cop. Wks.), Perth Amboy, N.J.	United Metals Selling Co., New York
White Pine Copper Co	2	White Pine, White Pine, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, Hubbell, Mich	Calumet & Hecla, New York
Wolverine Copper Mining Co	3	Wolverine, Gay, Mich	Michigan Smelting Co., Houghton, Mich	Michigan Smelting Co., Houghton, Mich	Wolverine Copper Mining Co., New York

(*a*) In 1919. (*b*) In 1918. (*c*) Expected normal production. (*d*) Information partially from unofficial sources, and possibly inaccurate. (*x*) Now closed down (Jan., 1921).

COMPANY REPORTS

Nevada Consolidated Net Profit 12c. per Share

A report of operations of Nevada Consolidated Copper Co. for 1920 states that a net profit from all sources of $235,904 was earned (about 12c. per share, compared with 61c. in 1919). The following statement gives operating results:

Operating revenue:		
Copper produced—48,311,985 lb. @ 17.767 f.o.b. Atlantic seaboard	$8,583,356.99	
Gold and silver produced	483,668.46	$9,067,025.45
Operating expenses		9,261,443.83
Net loss from operations plus depletion		$194,418.38
Miscellaneous income:		
Dividends on investments—Nevada Northern Ry. Co.	$350,000.00	
Interest and miscellaneous income	80,322.81	430,322.81
Total income from all sources—to surplus account		$235,904.43
Surplus from operations:		
Balance Dec. 31, 1919		8,160,533.02
Net income and proceeds of depletion		235,904.43
		$8,396,437.45
Capital distributions	$1,499,592.75	
Additional income and excess profits tax, 1917	358,242.46	1,857,835.21
Balance Dec. 31, 1920		$6,538,602.24

CURRENT ASSETS AND LIABILITIES

	Dec. 31, 1920	Dec. 31, 1919
Assets		
Metals on hand and in transit	$7,017,301.57	$8,129,985.98
Accounts and notes collectible	417,441.72	650,720.92
Deferred accounts	96,708.37	95,252.00
Materials and supplies on hand	1,860,558.70	1,781,539.04
Cash	553,413.14	1,589,173.94
Total current assets	$9,945,423.50	$12,246,671.88
Liabilities		
Current accounts	$694,134.03	$1,126,585.92
Treatment charges on metals (not due)	548,240.43	825,411.03
Total current liabilities	$1,242,374.46	$1,951,996.95
Surplus quick assets	$8,703,049.04	$10,294,674.93

Current assets do not include stock of the Nevada Northern Ry. Co. amounting to $2,000,000 par value. Net cost of production was 17.28c. per lb. of copper, compared with 16.14c. for 1919. Capitalization: $9,997,285, in shares of $5 par value.

Utah Consolidated Shows Deficit

Copper-Lead; Utah

A report of the Utah Consolidated Mining Co. for the year 1920 states that 3,187,492 lb. of copper, 9,999,350 lb. of lead, 273,730 oz. of silver, and 4,697 oz. of gold were produced. A net loss of $196,140.08 is shown by the following income account:

EXPENSE

Exploring and development	$374,569.86
Mining, including operating aerial tramway	730,199.40
Smelting	475,835.65
Refining and selling	54,384.86
Administration, including taxes	38,692.57
Legal and professional charges	6,028.65
Litigation expense	49,058.79
Depreciation	79,199.10
Total	$1,807,968.88

INCOME

Sales of metals		$2,023,579.28
Deduct decrease in value of metals on hand:		
Inventory at beginning of year	$924,178.45	
Inventory at end of year	430,348.29	493,830.16
		$1,529,749.12
Rentals and miscellaneous receipts		28,492.02
Interest		20,587.66
Dividends on Anaconda Copper Mining Co. stock		33,000.00
Balance, net loss		196,140.08
Total		$1,807,968.88

Surplus on Dec. 31, 1919, amounted to $1,459,295.22; on Dec. 31, 1920, to $1,263,155.14. Metals on hand are valued at $430,348.29.

Anaconda Earned $1.15 per Share in 1920

A report of operations of the Anaconda Copper Mining Co. for 1920 states that production was as follows:

Plant	Copper (Lb.)	Zinc (Lb.)	Lead (Lb.)	Silver (Oz.)	Gold (Oz.)
Copper reduction	155,339,575	.....	.....	7,113,659	32,530
Zinc	2,173,080	101,332,458(a)	12,536,088	2,073,349	6,151
International Sm.	9,909,763	.....	46,137,752	4,182,881	22,593
Miami Smelter	165,791,986	.....	.....	378,090	5,380
Int. Ld. Ref.(b)	.....	.....	49,173,237	3,438,371	11,897

(a) Also 5,255,452 lb. of zinc dross. (b) Includes 23,457.4 tons of lead bullion from International Smelting Co.

Consolidated income account shows a net income of $2,691,661 derived as follows:

Expense:	
Metals in process and on hand at beginning of year	$28,705,375.47
Mining, including development	17,943,878.52
Ore purchases	13,813,410.19
Reduction, including transportation of ore	19,248,563.22
Refining and selling, including transportation of metals	4,963,639.08
Cost of manufactured products and merchandise sold	5,664,682.26
Administration, Federal taxes and loss on Government securities sold	1,935,451.94
Balance carried down	8,020,165.93
	$100,295,166.61
Sales of metals	$53,227,278.08
Sales of manufactured products and merchandise	7,716,975.88
Royalties, tools, rentals, etc	6,814,729.76
Metals in process and on hand at end of year	32,536,182.89
	$100,295,166.61
Amount charged off this year for depreciation and obsolescence of mining plants, smelters, refineries, etc	$4,300,349.22
Interest	2,343,243.34
Balance, net income	2,691,660.62
	$9,335,253.18
Balance brought down	8,020,165.93
Income from investments in sundry companies	1,315,087.25
	$9,335,253.18

Surplus balance Dec. 31, 1919, was $89,055,552, plus net income of $2,691,661 and minus dividends paid amounting to $6,993,750, giving a surplus Dec. 31, 1920, of $84,753,463. Capitalization, 2,331,250 shares of $50 par.

Ray Consolidated Income Declined

A report of operations of Ray Consolidated Copper Co. for 1920 states that net income, exclusive of Federal taxes, amounted to $911,675, or 58c. per share, compared with $1,666,270, or $1.05, for 1919. Operating statement follows:

Operating revenue from metals produced:		
Copper produced—47,062,030 lb. at 17.502c.	$8,236,782.71	
Silver produced—4,365.29 oz. at $1.0045	4,384.19	
Gold produced—642.73 oz. at $20.00	12,854.62	
		$8,254,021.52
Operating expenses:		
Mining and milling	$5,129,950.01	
Treatment, refining and freight	2,153,745.24	
Selling commission	57,277.12	
Mine development extinguishment	256,594.50	
		7,597,566.87
Net income from operation plus depletion		$656,454.65
Miscellaneous income:		
Net miscellaneous income		255,220.59
Balance to surplus account		$911,675.24
Surplus from operations:		
Balance—Dec. 31, 1919		14,929,732.27
Net income and proceeds of depletion		911,675.24
		$15,841,407.51
Dividends	$184,596.66	
Capital distributions	1,392,582.34	
		1,577,179.00
Balance Dec. 31, 1920		$14,264,228.51

Total current assets on Dec. 31, 1920, were $9,152,742, a decrease of $1,555,457 during the year. Current liabilities were $8,166,276, a decrease of $739,945. Net cost of production was 15.565c. per lb., compared with 14.94c. in 1919, which includes all credits. Capitalization, $15,771,790 (par $10). Surplus on Dec. 31, 1920, was $14,271,384, compared with $14,932,937 for the previous year.

MINING STOCKS

Week Ended May 7, 1921

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Adventure	Boston	⅜	⅜	⅜		
Ahmeek	Boston	55½	52½	52½	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	⅛	1/16	⅛		
Alliouez	Boston	23	22	22	Mar. '19	1.00
Anaconda	New York	42⅜	41	42	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2½	2½	2½		
Ariz. Com'l	Boston	9½	9⅜	9½	Oct. '18,	.50
Big Ledge	N. Y. Curb	1/16	⅛	1/16		
Bingham Mines	Boston	....	....	9¼	Sept. '19, Q	.25
Calumet & Arizona	Boston	52¾	52	52	Mar. '21, Q	.50
Calumet & Hecla	Boston	257	253	253	June '20, Q	5.00
Canada Copper	N. Y. Curb	....	....	*13		
Centennial	Boston	10	9½	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	30⅛	29	30	Mar. '21, Q	.50
Chile Copper	New York	12⅛	11⅜	12		
Chino	New York	25⅛	24½	25⅛	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	*29	*25	*29		
Con. Arizona	N. Y. Curb	....	....	1/16	Dec. '18, Q	.05
Con. Copper M.	N. Y. Curb	....	....	1⅛		
Copper Range	Boston	36¼	34⅛	35⅛	Sept. '20, Q	.50
Crystal Copper (new)	Boston Curb	*35	*28	*29		
Davis-Daly	Boston	7	6½	6½	Mar. '20, Q	.25
East Butte	Boston	9½	9	9⅛	Dec. '19, A	.50
First National	Boston Curb	*85	*75	*85	Feb. '19, SA	.15
Franklin	Boston	....	....	2¼		
Gadsden Copper	N. Y. Curb	....	....	*25		
Granby Consol.	New York	23½	21⅞	23	May '19, Q	1.25
Greene-Cananea	New York	25⅛	24⅛	25	Nov. '20, Q	.50
Hancock	Boston	3	3	3		
Howe Sound	N. Y. Curb	....	....	2¼	Jan. '21, Q	.05
Inspiration Consol.	New York	37⅛	36	36⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	6⅝	6½	6⅝	Sept. '20, K	.25
Isle Royale	Boston	22⅛	21⅛	22⅛	Sept. '19, SA	.50
Kennecott	New York	22⅛	20½	21⅛	Dec. '20, Q	.50
Keweenaw	Boston	....	....	1⅛		
Lake Copper	Boston	2½	2½	2½		
La Salle	Boston	....	....	2⅛		
Magma Chief	N. Y. Curb	....	....	*21		
Magma Copper	N. Y. Curb	22⅛	21⅛	22	Jan. '19, Q	.50
Majestic	Boston Curb	....	....	*9		
Mason Valley	Boston	....	....	1½		
Mass Consolidated	Boston	2⅛	2⅛	2⅛	Nov. '17, Q	1.00
Mayflower-Old Col.	Boston	4⅜	4⅛	4⅜		
Miami Copper	New York	23⅛	22⅝	23⅛	Feb. '21, Q	.50
Michigan	Boston	3⅛	3⅛	3⅛		
Mohawk	Boston	55	51	53	Nov. '20, Q	1.00
Mother Lode (new)	N. Y. Curb	5⅛	4⅞	5⅛		
Nevada Consol.	New York	12⅛	11⅛	12⅛	Sept. '20, Q	.25
New Baltic	Boston Curb	....	....	3		
New Cornelia	Boston	16¼	15⅜	16	Aug. '20, K	.25
Nixon Nevada	N. Y. Curb	....	....	*5		
North Butte	Boston	11⅛	10⅞	10⅞	Oct. '18, Q	.25
North Lake	Boston	....	....	½		
Ohio Copper	N. Y. Curb	....	....	1/16		
Old Dominion	Boston	22⅛	21	21	Dec. '18, Q	1.00
Osceola	Boston	32	30⅛	31	June '20, Q	.50
Phelps Dodge	Open Mar.	†160	†140	....	Apr. '21, Q	1.00
Quincy	Boston	43	40	42	Mar. '20, Q	1.00
Ray Consolidated	New York	14⅛	13⅞	14⅛	Dec. '20, Q	.25
Ray Hercules	Boston Curb	....	....	*35		
St. Mary's Min. Ld.	Boston	40	38	38½	June '20, K	2.00
Seneca Copper	Boston	17⅞	16½	17⅞		
Shannon	Boston	1	1	1	Nov. '17, Q	.25
Shattuck Arizona	New York	6¼	6	6¼	Jan. '20, Q	.25
South Lake	Boston	....	....	1⅛		
Superior Copper	Boston	4⅛	4	4	Apr. '17,	1.00
Superior & Boston	Boston	1⅛	1⅛	1⅛		
Tenn. C. & C. cfs	New York	10⅛	9⅛	9⅛	May '18, I	1.00
Toulumne	Boston	*69	*44	*57	May '13,	.10
United Verde Ex.	Boston Curb	28⅛	26⅛	27⅛	Feb. '21, Q	.50
Utah Consol.	Boston	4⅛	3⅜	4⅛	Sept. '18,	.25
Utah Copper	New York	56	53⅜	54⅛	Mar. '21, Q	1.00
Utah M. & T.	Boston	1⅛	1⅛	1⅛	Dec. '17,	.30
Victoria	Boston	*60	*40	*55		
Winona	Boston	*60	*45	*60		
Wolverine	Boston	12	11½	11¾		
NICKEL-COPPER						
Internat. Nickel	New York	17	16	16½	Mar. '19,	.50
Internat. Nickel, pf.	New York	85	84½	85	May '21, Q	1.50
LEAD						
National Lead	New York	81	76⅛	80⅛	Mar. '21, Q	1.50
National Lead, pfd.	New York	108	108	108	Mar. '21, Q	1.75
St. Joseph Lead	New York	12⅛	12	12⅛	Mar. '21, Q	.25
Stewart Mining	Boston Curb	....	....	*6	Dec. '15,	.05
ZINC						
Am. Z. L. & S.	New York	9⅛	9⅛	9⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	28⅛	28	28⅛	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅝	5	5	June '18,	.50
Butte & Superior	New York	15⅛	14	15	Sept. '20,	1.25
Callahan Zn-Ld	New York	5⅛	5⅛	5⅛	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	127	123	127	May '21, Q	2.00
Success	N. Y. Curb	*3	*2	*3	July '16,	.03
Yellow Pine	Los Angeles	*50	*50	*50	Sept. '20, Q	.03

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	1/16	⅛	⅛		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Carson Hill	N. Y. Curb.	15⅛	14⅛	14⅛		
Cresson Consol. G.	N. Y. Curb	1⅛	1⅛	1⅛	June '20, Q	$0.10
Dome Extension	Toronto	....	....	*60½		
Dome Mines	New York	20	18⅛	18⅛	Apr. '21, Q	.25
Golden Cycle	Colo. Sprgs.	*76¾	*74	*74	Dec. '20, Q	.02
Goldfield Consol.	N. Y. Curb	*8	*6½	*8	Dec. '19,	.05
Hollinger Consol.	Toronto	7.30	7.22	7.25	Feb. '21, M	.05
Homestake Mining	New York	57	56	57	Sept. '19,	.50
Kirkland Lake	Toronto	*54	*50½	*50½		
Lake Shore	Toronto	1 38	1 29	1.34	Jan. '21, K	.02
McIntyre-Porcupine	Toronto	2.03	1.99	2.03	Jan. '21, K	.05
Porcupine Crown	Toronto	*28	*27½	*27½	July '17,	.03
Portland	Colo. Sprgs.	*63	*60	*63	Oct. '20, Q	.01
Reorgan. Booth	N. Y. Curb	*4	*3	*4	May '19,	.05
Silver Pick	N. Y. Curb	*6	*4	*5½		
Teck Hughes	Toronto	*18	*16½	*16½		
Tom Reed	Los Angeles	0.90	0.83	0.83	Dec. '19,	.02
United Eastern	N. Y. Curb	2⅛	2⅛	2 11/16	Apr. '21, Q	.15
Vindicator Consol.	Colo. Sprgs.	*33	*31	*33	Jan. '20 Q	.01
West Dome Consol.	Toronto	*7½	*7½	*7½		
White Caps Mining	N. Y. Curb	*6	*5	*6		
Yukon Gold	Boston Curb	....	....	*70	June '18,	.02½
SILVER						
Arizona Silver	Boston Curb	*27	*17	*19	Apr. '20, M	.03
Batopilas Mining	New York	⅛	1/16	⅛	Dec. '07, I	.12½
Beaver Consol.	Toronto	*34½	*34½	*34½	May '20, K	.03
Coniagas	Toronto	1.80	1.75	1.75	May '21, Q	.12½
Crown Reserve	Toronto	*12½	*12½	*12½	Jan. '17,	.05
Kerr Lake	Boston	3½	3½	3⅜	Apr. '21, Q	.12½
La Rose	Toronto	....	....	*23	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*17	*17	*17	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.00	1.00	1.00	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	5	4½	4½	Apr. '21, Q	.15
Ontario Silver	New York	5⅞	5	5⅞	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	2	1⅞	2	Jan. '12,	.10
Peterson Lake	Toronto	*6½	*6½	*6½	Jan. '17,	.01½
Temiskaming	Toronto	*20	*20	*20	Jan. '20, K	.04
Trethewey	Toronto	*19	*16	*16	Jan. '19,	.05
GOLD AND SILVER						
Atlanta	N. Y. Curb	*1	*⅞	*1		
Barnes-King	Butte	‡	....	1.10	Aug. '20, Q	.05
Boston & Montana	N. Y. Curb	*66	*62	*64		
Cashboy	N. Y. Curb	*6	*4	*6		
El Salvador	N. Y. Curb	¼	¼	‡		
Jim Butler	N. Y. Curb	*10	*8	*9	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*7½	*6	*7	June '16,	.05
Louisiana Con.	N. Y. Curb	....	....	‡		
MacNamara M.& M.	N. Y. Curb	*31	*14	*26	May '10,	.02½
N. Y. Hond. Rosar.	Open Mar.	†10½	†9	....	Jan. '21, Q	.30
Tonopah-Belmont	N. Y. Curb	1⅞	1⅞	1⅞	Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	1⅛	1⅛	1⅛		
Tonopah-Extension	N. Y. Curb	1⅛	1 1/16	1⅛	Apr. '21, Q	.05
Tonopah Mining	N. Y. Curb	1 1/16	1 1/16	1 1/16	Apr. '21, SA	.05
West End Consol.	N. Y. Curb	1 1/16	1 1/16	1⅛	Dec. '19, SA	.05
SILVER-LEAD						
Caledonia	N.Y. Curb	*12	*10	*12	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	....	....	.15	Dec. '20,	.15
Chief Consolidated	Boston Curb	2⅛	2⅛	2⅛	May '21, Q	.05
Consol. M. & S.	Montreal	17	15	15	Oct. '20, Q	.62½
Daly Mining	Salt Lake	....	....	2.50	July '20, Q	.10
Daly-West	Boston	2⅛	2⅛	2⅛	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	....	....	2⅛	Apr. '21, K	.05
Electric Point	Spokane	*7¼	*7	*7	May '20, SA	.03
Federal M. & S.	New York	9	9	9	Jan. '09,	1.50
Federal M. & S., pfd.	New York	26	25	25⅛	Mar. '21, Q	1.00
Florence Silver	Spokane	....	....	*16	Apr. '19,	.01½
Grand Central	Salt Lake	....	....	*07½	June '20, K	.03
Hecla Mining	N. Y. Curb	4¼	4 1/16	4 1/16	Mar. '21, Q	.15
Iron Blossom	N. Y. Curb	....	....	*15	Apr. '20, Q	.02½
Judge M. & S.	Salt Lake	....	....	3.00	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*11	*5	*10		
Prince Consol.	N. Y. Curb	⅛	1/16	1/16	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*5	*5	*5	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*14	*10½	*12		
South Hecla	Salt Lake	....	....	*65	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	1/16	1/16	1/16	Oct. '17,	.05
Tamarack-Custer	Spokane	1.75	1.70	1.70	Jan. '21, K	.04
Tintic Standard	Salt Lake	2.62½	2.45	2.50	June '20, Q	.10
Utah Apex	Boston	2⅛	2 1/16	2 1/16	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*4½	*3	*4	Nov. '17,	.01
QUICKSILVER						
New Idria	Boston	....	....	*50	Jan. '19,	.25
VANADIUM						
Vanadium Corp.	New York	40⅜	35½	38½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	61	58	60	Apr. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	82	80½	82½	Apr. '21, Q	1.75
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	44¼	41⅛	42	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	78½	77½	77¾	Mar. '21, Q	1 75
Am. Sm. pf. A	New York	70	70	70	Apr. '21, Q	1.50
U. S. Sm. R. & M.	New York	34¼	33¼	33½	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	Boston	42	40½	42	Apr. '21, Q	.87½

* Cents per share. † Bid or asked. ‡ Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.

INDUSTRIAL NOTES

New Uehling CO_2 Recorder Aids Fuel Saving

The soaring price of fuel is causing plant owners and operators to use the available means for reducing fuel waste, notably CO_2 recorders, to a greater extent than ever before.

The greatest single waste of fuel is heat discharged up the chimney, which represents over 35 per cent of the fuel in the average boiler plant. Continuous CO_2 determinations enable firemen and engineers to co-operate in burning fuel with the most efficient proportion of air. They also show up other causes of boiler inefficiency, so that wasteful practices may be "nipped in the bud."

The Uehling Instrument Co., 71 Broadway, New York, has introduced a new model CO_2 recording equipment, known as style U, which embodies important improvements over the superseded model. Chief among its advantages are quick action, accessibility and simplicity, and the combination in one machine of determinations simultaneously from any number of boilers up to six.

A single unit Uehling CO_2 equipment for one boiler consists of three principal parts, namely: the meter proper, the recorder, and the auxiliary boiler front indicator. The meter is placed wherever most convenient. Its function is to actuate the boiler front indicator and recorder in the engineer's office.

The CO_2 meter consists essentially of a cylindrical regulator on which is mounted the analyzing mechanism. This regulator maintains constant the suction created by the aspirator, thereby eliminating all changes in tension except those caused by absorption within the absorbent carton chamber which takes up the CO_2. The latter's changes in tension are given by the indicator and recorder.

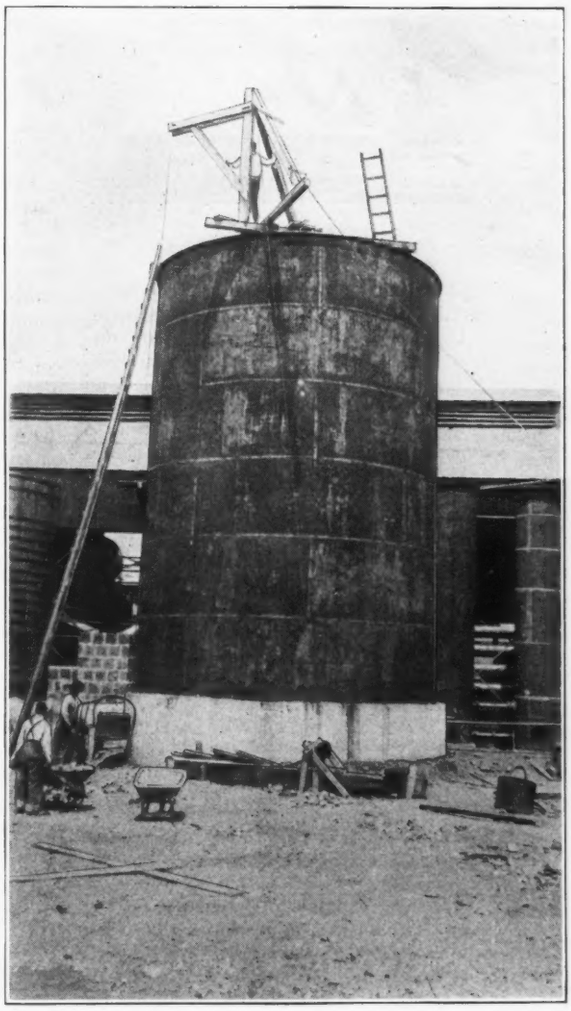
The recorder operates on the hydrostatic principle, by which all springs, levers and joint movements are avoided. It makes a continuous, (not intermittent) record of the per cent CO_2, furnishing an autographic history of the operation of each boiler for every second of the day, showing when fires receive attention; when and how often furnace doors are opened; fires cleaned; dampers regulated; and giving the fireman a square deal.

The boiler front indicator guides the fireman in supplying just the right amount of air to burn the fuel with the least loss of heat up the chimney.

Largest Welded Tank Completed at Birmingham, Ala.

What is believed to be the largest welded tank ever built was recently completed by the Welded Products Co. at Birmingham, Ala., for the Liquid Carbonic Co. The tank is 22 ft. in diameter and stands 30 ft. high. It was made of ¼-in. steel plates, joined at the seams by oxy-acetylene welding. The tank has satisfactorily withstood the required tests and has been found to be gas-tight in all of the welded seams under excess pressures.

The Welded Products Co. uses oxy-acetylene with remarkable success in tank construction, and has for some time specialized in this field of welding, having built many large tanks for gasoline storage and other uses in the South. The welded construction has been proved thoroughly satisfactory and much cheaper than riveted tanks of the same capacity. The welded tank has a distinct advantage also in the fact that it is not so susceptible to rust as the riveted tank. The company has a well-equipped welding plant and uses the latest improved Oxweld apparatus throughout. Linde oxygen is supplied to the blowpipes through a system of shop piping. The company is now estimating on the gas holders for the new plant of the Linde Air Products Co. at New Orleans, and if awarded this contract there will soon be a new "largest welded tank" to take its rank in the welding field and, incidentally, to open up an entirely new outlook for the industry.



LARGEST WELDED TANK BUILT BY WELDED PRODUCTS CO.

New Diesel-Driven Ore Boat Runs Eleven Knots on Nine Tons of Oil Daily

An unusual type of vessel with internal-combustion engines has just been launched at Gothenburg, Sweden, for the Grangesburg Ore Co., according to a writer in *The Times Engineering Supplement*, London, April, 1921. The new vessel has been specially designed for the transport of ore, and the decision to adopt Diesel motors for propulsion was made only after careful investigations. Owing to the shorter engine room and the absence of cross bunkers, the distribution of cargo is better than in a steamer, and the separate ore heaps may be made much lighter, thus diminishing the stresses on the hull. The vessel is 385 ft. long between perpendiculars and is capable of carrying 8,000 tons. Two Diesel engines of 1,300 indicated horsepower will give a speed of eleven knots, and the total fuel consumption will be about nine and one-half tons per day. The oil bunker capacity is about 500 tons.

The engine room is placed amidships, allowing three large cargo holds forward, and three aft, all served by electrically operated winches. Five ships of the same size and type are being constructed in Gothenburg by the Gothenburg Shipbuilding Co., and a contract has been made for eleven similar vessels. It has not yet been decided whether steam or internal-combustion machinery shall be installed in these latter craft, but in all probability they will be equipped with oil engines.

Although these boats are far smaller than the great American ore carriers, they may comprise some instructive and utilitarian innovations worthy of careful study.

Shale Treatment Plant for Nova Scotia

The Nova Scotia Oil Shale Fields, Inc., Harold C. E. Spence, president, has closed a contract with the Carbonization Co., Ltd., of Pittsburgh and New York, for the Arthur L. Pearse process for treating oil shale. The company will begin the erection of a plant near New Glasgow, N. S., at once and may be at work by Christmas.

Progress in Applying Electricity to Mining Illustrated by Recent Engineering Accomplishments of the Westinghouse Company

The most notable engineering achievements of the Westinghouse Electric & Manufacturing Co. for the past year have probably been those in connection with business obtained from many of the most important customers, because of the great business activity through which we have passed. In the mining industry attention should be called to a 1,700-hp. 25-cycle motor driving a turbine type blower supplied to the Inspiration Consolidated Copper Co.

A large number of unique motors for vibrating screens, capable of broad application in the mining and allied industries, were put out. Through close co-operation with the engineers of the Utah Copper Co. this special motor has been developed for the Mitchell vibrating screen, which promises to revolutionize the principle of handling materials wherever classification by volume is done.

A new and novel idea in the drilling of oil wells with electric motors, perfected during 1920, consists of two standard two-speed pumping motors driving the same countershaft and performing more successfully the operations incident to drilling. This arrangement promises to entirely revolutionize accepted drilling methods.

The electro-chemical and electro-metallurgical field is always subject to new developments owing to the improved method of applying electricity in many of the branches of this art, and the last year was no exception. A new furnace regulator promises to give better results than any regulator yet manufactured. Ten of these regulators are now in successful commercial service. Another regulator, known as the step-induction type, has been developed to take the place of the old type induction regulator. Some 30 regulators of this type are now in commercial use for controlling graphite, carborundum, zinc and similar furnaces.

The largest and most spectacular installation of Cottrell precipitating apparatus during 1920 was supplied by the Westinghouse company to the United Verde Copper Co. at Jerome, Ariz.

The past year has seen a further development of the largest installation of electric shovels in the world. This is at the mines of the Chile Exploration Co., Chile. The enormous quantities of low-grade ore must be mined at low unit cost. Steam shovels, which usually cost considerably more to operate than electric shovels, were formerly used for this work. In this particular case the cost of operation of the steam shovels was even higher than usual, due to the fact that coal and water had to be hauled long distances from the company's property at the sea coast to the mountain. Five large electric Bucyrus shovels driven by Westinghouse alternating-current motors were installed in the latter part of 1917, the power being transmitted at a high voltage, which is reduced to 500 volts by step-down transformers located on the rear of the shovels. The operation of these shovels was so successful and the reduction in cost so great that five more were placed in operation at these mines during 1920. The hoist motion on the shovel is driven by a 250 hp. motor and the swing and thrust motions each by a 75 hp. motor.

New Clamps Simplify Mine Trolley Set-Up

Two new trolley clamps are being manufactured by The Ohio Brass Co., Mansfield, Ohio.

O-B Wedge Clamp shown in Fig. 1,

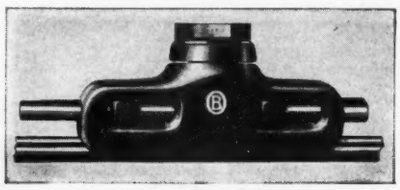


FIG. 1. O.-B. WEDGE CLAMP

which is of a type especially popular in certain fields, embodies some new ideas.

It aligns with the wire without setting up strain in the hanger insulation. After the clamp has been screwed on the hanger and before the wedge is driven in, the jaws rotate enough to come into line with the trolley. Then, a

FIG. 2. O.-B. PREMIER CLAMP

few blows with a hammer on the wedge tightens the clamp on the wire and on the hanger.

Another worth-while feature is the even distribution of pressure along the whole length of the jaws.

O-B Premier clamp (see Fig. 2) is interesting principally because of its simplicity. Two jaws, the boss and the jam nut are the only parts. Hence these few pieces have been made very heavy and strong without raising the cost of the clamp out of the low price class.

One of the many oil companies that have adopted "Caterpillar" Tractor power for the transportation of oil-field supplies and equipment is the Cooper-Henderson Oil Co., Consolidated, of Breckenridge, Texas. The employees of the company affectionately refer to the tractor as the "Old Cat," and it has well earned their regard.

TRADE CATALOGS

Mills—The Mine and Smelter Supply Co. has recently issued two pamphlets which should be in the files of every millman and metallurgist. One (Catalog 62) is devoted to the Marcy ball mill, a thoroughly tested and widely installed machine. It gives information about all of the Marcy features, together with dimensions and data on the various sizes manufactured. It is much more complete than the old catalog. The other brochure is devoted to photographs of the new Marcy roller mill, an improved type of rod mill. Views of the original experimental unit at Anaconda are given and also pictures of the more up-to-date mills which have been designed for the Phelps Dodge properties.

Belt Conveyors. — The Stephens-Adams Manufacturing Co., Aurora, Ill., announces the publication of a new catalog, No. 26, dealing with S-A belt conveyors. The publication, which comprises more than a hundred pages, contains useful engineering and mechanical information relating to belt-conveyor practice, including tabular and graphic data. Concise descriptions of equipment, with illustrations, complete the publication, which will be sent on request.

Dust Collectors.—The Dust Recovering & Conveying Co., Cleveland, Ohio, recently distributed its bulletin No. 12, illustrating "The development of dust-collecting equipment," which has culminated in the "Dracco Perfecto" type, which has the filters between the dust source and the draft-creating fan. The result is immunity from dust explosions due to filter, and longer life for the fan.

Wilfley Tables—The Mine & Smelter Supply Co. has issued an attractive and convincing book describing Wilfley concentrating tables. The Wilfley table has been used for twenty-five years, and it has become so generally known throughout the world that the word "Wilfley" has almost assumed the status of "kodak" and "victrola" and is used as a generic term without regard to the manufacturer. A perusal of this book will show (although most of those who see it will already know the fact) that the manufacturers have not been willing to sit back and let well enough alone, but have made numerous improvements in design to keep the table abreast of the times. Many different riffle systems have been devised for different kinds of work, for example, and the buyer of a Wilfley table is by no means confined to the standard system as commonly seen. A chart giving the relative specific gravities of common minerals and metals in a handy form adds to the reference value of the book. Ask for Bulletin No. 64 when writing.